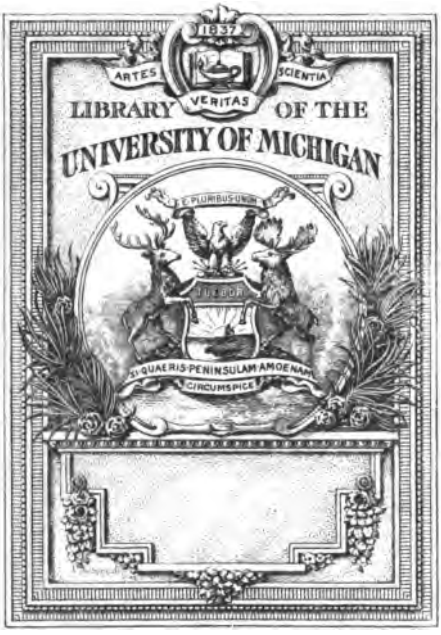

1837
ARTES
SCIENTIA
VERITAS
LIBRARY OF THE
UNIVERSITY OF MICHIGAN
E PLURIBUS UNUM
SI QUAERIS PENINSULAM AMOENAM
CIRCUMSPICE

RAILROAD OPERATIONS

HOW TO KNOW THEM

From a Study of the Accounts and Statistics

BY

J. SHIRLEY EATON

Statistician of the Lehigh Valley Railroad

PUBLISHED BY

THE RAILROAD GAZETTE

32 PARK PLACE, NEW YORK

1900

THE MERSHON COMPANY PRESS,
RAHWAY, N. J.

PREFACE.

Mr. William Mahl, comptroller of the Southern Pacific system, has tritely described statistics as the method of disciplining a property. This applies with equal force whether from the standpoint of the manager, the investor, or the public.

In this contribution to the general subject, the effort has been to work out some of the principles on which railway statistics rest, show how they should be used for practical results, and point out fallacies to be avoided. Exact figures, because of the special condition which are necessary to explain them, have been carefully avoided.

It is hoped it may prove useful to managers, investors, students, and railway experts.

J. S. E.

NEW YORK, *February 1, 1900.*

CONTENTS.

CHAPTER I.

CHAPTER II.

CHAPTER III.

CHAPTER IV.

CHAPTER V.

CHAPTER VI.

CHAPTER VII.

CHAPTER VIII.

CHAPTER IX.

CHAPTER XII.

CHAPTER XIII.

CHAPTER XIV.

CHAPTER XV.

CHAPTER XVI.

CHAPTER XVII.

CHAPTER XVIII.

CHAPTER XIX.

CHAPTER XX.

CHAPTER XXI.

CHAPTER XXII.

CHAPTER XXIII.

RAILWAY OPERATIONS—HOW TO KNOW THEM.

HINTS FOR EXAMINING A RAILROAD PROPERTY.

1. How can a railroad go bankrupt with a big surplus on its balance sheet? Certainly this is an obvious question, but the answer is simple. The surplus as a real quantity is a very relative thing. It is only, up to the amount of its value, the offset of property for which there is no other claim. Its claim is not to any specific part of the property, but lies against the whole property, composed of parts in all stages of convertibility. When the quick assets become less than the immediate claims, and the railroad has not better times in prospect and credit to tide it over, there is no recourse but a receivership. The property may be entirely solvent if only the lost balance between quick assets and current liabilities can be restored. In practice this has been a regularly recurring process on many of the railroads of the country, which they do by funding their floating debts. Therefore, the first thing is to rudely break up the general balance sheet into groups of assets according to their negotiability, and liabilities, according to their maturity or pressing, present demand. From these we form a judgment of the immediate financial condition of the property.

2. The next question is, "Was the dividend earned?" which is the constant and great first question throughout all railroad operation. It is simply stating in another form the question, "Is the surplus

real?" except that the inquiry is confined to the period which the earning covers. Our working tools are the balance sheet, income account, operating account, income and operating accounts of subsidiary properties, profit and loss account, perhaps the treasurer's account and the miscellaneous traffic and operating tables. The balance sheet is the critical point of the examination. The other data are supplementary and explanatory. A railroad has been described as essentially a "going" affair. The property, plotted out on the balance sheet under different heads, was at rest only at some fictitious instant of time, for it is in constant change. It is a ceaseless process of wear and renewal, consumption and supply—the change of form for the production of value. Income is the net proceeds of this change. The probable effectiveness of outlay to produce return rests on a great variety of conditions, present and prospective. A statement of earnings is, after all, a statement of judgment and not of actual physical facts. It may differ widely according as it is formed in heedless optimism or timid conservatism. This is why the investor should revise for himself the statement of any management, however honest or generally wise.

3. By comparing one balance sheet with another we bring into outline the changes in the intervening period. The income account is the statistical register of so much of these changes as are thought to have an effect on earnings or values. The cash account registers such changes as involve cash, regardless of effect on earnings or values. The profit and loss account is sometimes made to register, in addition to the increments from income account, other changes of value that for some reason may not have passed through the income account. Our examination is into all of these accounts to see if the changes in the property, which in our judgment affect values during the

period under review, have been registered in the income account. We want to know that they have not been misapplied, overstated, understated, or omitted. Queerly enough there is no significance for our purposes in the exact amount of any of the general items on the balance sheet, but only in the amount of change, during the period examined. They are like the engineer's bench mark, which may serve all his practical uses without his ever knowing its absolute elevation.

4. In order to compare two balance sheets draw off the discrepancies under each head in a debit and credit statement. Construction and new property must be carefully explained by detail tables. We must first form a judgment of the cost of each item, then of its relation to the railroad's needs and its probable revenue-producing effect on the property. Discrepancies under either head should be carried to a memorandum account, from which we will finally revise the income statement as given on the report. Car-trust payments can only be judged by facts as to the trust itself. Acquisitions in shape of securities of other properties or advances to them should be most carefully scrutinized by examination of the revenue-producing power of those properties, as we would look to the mercantile rating of an individual before accepting his obligation as an asset. It is an old and worn-out trick of the early days of railroad bookkeeping to pad income by borrowing money to make advances, that have the appearance of legitimacy, to subordinate properties, and to get directly back such advances as incomes on investments. This is only possible where the operations of the subordinate property are not reported and the transaction is covered up. If the other property is not independent, but is subsidiary or is operated in part jointly, there may be considerations passed which are not reckoned at any market rating and given definite accounting. In such cases the advances may be

entirely legitimate, although it is very uncertain if they can ever be repaid, but they are a definite expense of current earnings and should be charged to income and not as an asset. To judge of the value of the traffic interchanged with such a road, turn to the traffic tables, which should show the tonnage and passengers received and delivered from this connection. From the average earnings per ton and per passenger and average length of haul, and average train expense per mile we may rudely, in absence of more complete data, calculate the amount of this advantage and balance it against the money advanced.

5. Turn to operating expenses and examine critically the maintenance items, placing them appropriately against the road mile, car mile, or other unit. See if insurance, reserve, and depreciation funds are kept up. If maintenance charges are light, the indication is that the property is being neglected in order to produce present revenue, and some estimated correction should be applied to income account. Look carefully at accounts payable, audited voucher account, traffic balances due. They may represent overdue accounts that have been put off in order to show earnings. Look out for the item among the assets, of "station agents," also "remittances in transit." These are in the first place entirely legitimate items. But under a stress, managements have been known to authorize their agents to pay claims for overcharges that are direct deductions from earnings, and for lost or damaged freight, which are proper charges to revenue, and to leave the amount of such payments in their agents' accounts as collectible assets.

6. Out of all such items we have gathered sufficient information to revise the income account if we think necessary. If the examination is carried back over several years, we have the data for revising the suc-

cessive increments of the general profit and loss account. We may apply the total of the corrections at once to profit and loss on the general balance sheet, revising at the same time the other accounts affected. We are thus able to state what in our judgment is the amount of the actual earnings in the period examined.

7. But since the value of a railroad rests entirely on its earning power, it becomes necessary to examine critically into its tendency and into all the conditions on which it rests. First we examine it by comparisons with other years extending over a considerable period. Net earnings are the only real earnings, and we run over a series of years to see if they are on the increase or decline. It is common to use the per cent. of operating expenses to earnings as an index to earning power of the property. This is better than the net earnings, because net earnings are an amount expressing no relation, while the other form of statement is a per cent., showing the relation between earnings and expenses regardless of their varying amounts. From such indications as we get from the net figure, we pass over into examination of gross revenue and gross expense to locate the causes for fluctuation.

8. We begin with gross earnings, since causes that operate here are largely outside of our control. If they are long effective unfavorably, they must absolutely impair the revenue power of our property on which all its value rests. Glance over the gross earnings through several years. Is the line of their movement up or down? Analyze them by kinds of earnings and locate variations to each kind and length of haul. Note the volume, the density, and the average rate of change of each, and see where the trouble is. The traffic should further be analyzed into competitive and non-competitive. The groupings will be rough, but they will serve to indicate rudely the paying character of the business, and more especially the general

permanence of the entire volume of business, because competitive business is most uncertain. Some railways have in their reports gone into analysis of their traffic by gateways and connections. With a knowledge of the particular territory where the railroad operates we may interpret these statistics to judge whether the road is gaining or losing at the vital strategic points. Information should be at hand, though it cannot be tabulated, about any existing traffic arrangements, pools, differentials or agreed divisions of through business, to which the road is party, and which can be public information.

9. The other factor determining net earnings is expenses. We have previously looked at them to see if there has been any juggling with them to produce excessive earnings. We now want to see if they are themselves unduly high. The cause will be located either in bad operation or defective equipment and physical disabilities of the property. Look over the physical statistics of grade, weight of rail, miles operated and not owned, miles of second and side track. Note the type and weight of locomotives and capacity of cars. Next turn to operating statistics and look at the mileage of foreign equipment as compared with foreign mileage of home equipment. An item that vitally affects expenses is the permanent excess of empty car mileage in one direction. The train mile is taken as the great unit of operating expense. Note the "averages" per train mile through a series of years for each of the items of expense given. Then note the performance in tons per train and per loaded car, and in passengers per car and per train. The road maintenance should be examined per mile of road through a series of years. We should especially watch renewal of rail and ties which we may very definitely measure. The mileage per car per day is an index to good or bad management. Any joint operation or

joint expense, where of sufficient importance to appear on the report, will bear special attention. There may be ruinous contracts in force, for use of terminals or equipment or in the operation of "lines", and subordinate agencies or side businesses.

10. After all the specific conditions of a particular road have been examined, there remain those general commercial, industrial, and competitive conditions on which the permanence of its traffic ultimately rests. Trade and industrial statistics should, to a limited extent, be given, showing the activities throughout the territories served. The railroad's business should be related to these general conditions by analysis of its traffic by commodities, by seasons, also by export and import movement when such distinction is plain. General information as to the scope and effect of traffic associations in the territory served, the effect of legislative encroachments restricting the rate-making power, offering premium to ruinous competition, imposing excessive taxation, and the expense of separating grades, etc., also the general temper of the courts, the legislatures, and the public generally, is usually supplied by the president where it is necessary to explain the operations of the road. Added to all the foregoing considerations are the known character and personnel of the management and the associated financial interests behind them.

11. Unfortunately the data furnished by railroads in their annual reports are too often most unsatisfactory. Sometimes page after page is given over to tedious detail of miscellaneous physical properties which are items of no possible value outside of the engineer's office. We find that there is a siding .32 of a mile long at down-in-the-woods, that locomotive No. 72 had a new smokestack, that the water tank at Piney Flats has been replaced by one of ten thousand gallons greater capacity. But the intelligent grouping of all

these heterogeneous details, by which we may critically examine the general balance sheet and income account, is almost entirely neglected. That the public continue to invest where they have such scant knowledge can only be interpreted as a high compliment to the management. It is certainly wanting in the first principles of business prudence.

WATCHING FREIGHT TRAFFIC CURRENTLY.

1. We are watching gross earnings. There is, of course, the underlying idea that our traffic does produce net earnings, but the certainty and amount of this profit on each kind of business are matter for inquiry at a different time and in a more thorough way. Therefore, the cry of the traffic department for "tonnage," regardless of kind or distance hauled or amount of revenue, is not so mistaken. We cannot control the destination of single shipments, or regulate the length of the haul except in the case of the alternative routing of through business. We can only take the business that is offered, be its haul great or small; hence, the primary measure of the business we get is simply tons. irrespective of distance carried or class of freight. And for cursory review the uncertainty of these two elements is not so great as to entirely invalidate our results when only tonnage is used as the measure of the volume of business between any two periods, on the same road.

2. We want to know how this volume of business can be maintained or increased. We, therefore, classify it solely with reference to its "getability"—how much of it are we getting? This "getability" is conditioned by competing lines, competing markets, or competing producing points, and competing commodities. The grand division of all business into competitive and non-competitive is only a rude approximation. There are conditions under which any freight may at some time be considered competitive; that is, require to be bid for by itself. The most generally accepted form of competitive business is where two routes be-

tween the same producing and the same consuming centers bid for the same commodity. From this, the various kinds of competitive business shade off indefinitely into the local traffic business, which is called non-competitive. The difference between the more and the less competitive business is in the imminence of this competition as a direct acting force and not a mere potential quantity. The least competitive business is that which permits the widest margin of variation in the rate without affecting the volume of business. Practically, local business is so little affected by the rate that an arbitrary tariff is generally imposed, which is so seldom changed that it is called a " specific."

3. The simplest form of competitive business requires incessant watching, since it is most sensitive not alone to rates imposed, but also to conditions of service offered and enterprise of our soliciting department and perfection of our traffic arrangements. Perhaps the largest single class at the start is the through business, delivered by connections at gateways where we are one of several competing routes. Watch this tonnage weekly and at important points daily. Locate at once any decline and trace to the road causing it. The explanation must lie in a different traffic arrangement from a year ago or a falling off in the business from the territory which is served by the particular connection at fault. Where we interchange with the same road at several points it is necessary to know how much tonnage came by the long haul and how much by the short haul junctions. At gateways where the data are to be had, state the tonnage interchanged with each road in per cent. of entire dividable business. The movement of gateway freight should be watched at least as often as once a week. Except in case of special circumstances it will hardly be necessary to show it in the weekly statements by more detail than the gateway or the individual connection.

4. Next we turn to the great body of competitive freight, which is the tonnage at competitive points. These points should be grouped territorially for the weekly statement. Circumstances must dictate entirely, but in most cases it will hardly be necessary to examine the individual forwarding points oftener than once a month. It should be classified into certain leading classes, and car load and less than car load freight should be kept separate. But the number of commodities recognized in the classification need not be more than a half-dozen at the most, the residue being thrown into an "all other" class. These leading commodities need not be the same over the entire system, but should be the half-dozen leading articles in the various territories served where different classes of business prevail.

5. At the end of the month the forwardings from single points should be carefully examined. But the smallest points should be grouped as simply ordinary common points. Where the tonnage of any group has fallen off, if it cannot be explained by reference to the commodity that is at fault, then we should turn to the particular points which make a specially bad showing, and the explanation must be made by those on the ground who understand the local situation. These causes might be classified as temporary or permanent. But it must always be kept in mind that the tonnage at any one place cannot be held to a rigid figure at all. The best we may do is to take the increases or decreases as pointing to general tendencies.

6. The most vital point in freight movement is the forwarding point, generally. It is that point which, generally speaking, gets the business. But this is not always so. It is the destination which gives the market and makes possible the shipment. After the analysis of tonnage on the forwarding side, a similar though not so elaborate or frequent study is necessary on the

receiving side. Large points of destination would constitute single destinations and the smaller points should be grouped territorially. Explanation may lie in the fact that we have ceased to be part of certain through lines, and while the fact that we have lost business in that way may be known in a general way by the traffic official in that territory, yet the amount of such decline, until ascertained, is entirely a matter of guessing.

7. Now we will take up that very considerable class of tonnage that goes to competing markets or to the same market from competing producing points. This is not a certain and easy class to determine, but practically the distinction does exist and is very clearly marked, at times. Only the traffic man is in position to know just what business it is. It will be scattered at various points along the road and may be very miscellaneous. The point of origin and point of destination, together with the commodity, will describe it. Where once indicated by the traffic department, such tonnage should be regularly withdrawn each month from the general body to a class by itself. It should, perhaps, be shown by leading commodities, which will serve for reference in explaining the fluctuations in the general total. Explanations will largely lie in market conditions. It is the business that is most sensitive to industrial and commercial conditions, and it is the duty of the traffic man to detect at once any general tendencies and adjust his rate without delay. He generally does this on the complaints of individual shippers. But he must rely on their representations very largely unless he has some figures of his own by which he may watch for himself the actual effects of existing rates on special lines of traffic. Where the business on any commodity has fallen off, we must divide it up among the competing markets to which it went and find where we are losing ground. Some-

times the fault may lie with the producing point, and the traffic manager will be as jealous to guard the business from such decline as if it were his rate that was at fault. Wherever it is possible to get the figures of the movement to the competing market or to the same market from the competing producing territory, they should be examined in this connection, to see if our road is losing ground or whether the fault is in general commercial conditions under which our competitors are equal sufferers.

8. The last class of business that we would theoretically call competitive is so indefinite and irregular that in practice we would not have to deal with it separately. Currently we may judge of it by dividing up all business now left into leading commodities, by principal forwarding points, the smaller points being grouped territorially. This, of course, is all the remaining business, and is generally all grouped in this way as "local" traffic. Where the system is large it may sometimes be desirable to show the interchange of local traffic between divisions.

9. We now should have pretty well before the eye the result of the month's business, with the weak spots brought into clear profile. The detail is of vital importance for the subordinate officials, but the general officer or the president wants the extended observations reduced to general terms, so that the month's traffic can be stated in its proper relation to that of other months. Its decline or increase should be apportioned to the several general causes that are within the regulation of the traffic department, and to those other causes, either temporary or permanent, that belong to the wider field of general commercial and industrial conditions. The figures must suggest those general policies that take their initiative from the general officer. Unless the suggestions are given effect, and that promptly, we have done nothing more than

indulge in a little juggling with figures, which is highly curious and interesting, no doubt, but has utterly no value in dollars and cents to the road that is paying the bills.

10. The meaning of the figures must be brought home to every official and employee, however humble, who in any way or part can affect the conditions that control the traffic. Too much emphasis cannot be laid upon this. It is generally the point where all traffic statistics fail and statistics generally are brought into contempt. The system of making effective the findings of statistics is quite as important as the making of the statistics themselves. It will justify as elaborate methods and care. With every statistical statement, be the showing good or bad, there should at the same time be at hand the explanation of the man locally informed, that the remedy may be applied at once or the favoring conditions enhanced. These explanations are largely matters of judgment, but it is the judgment that the supervising official must rely upon and should be at hand the instant the figures are ready which call for explanation. These current judgments should be made by every station agent, however small his station. Too often he is advised of the decline of his business, and called on for an explanation six weeks or three months after the business was done. Very seldom is he called upon for an explanation for increases of business. In some way the superior official assumes that an increase is *per se* a good showing, without regard to whether it was as large an increase as it might have been. And, in calling for explanations so long after the business occurred, not only has the memory of the agent grown dim, but moreover he is called upon to give an explanation that is practically implied in the way the question is stated and he largely warps his explanation to correspond. It would be far better if all agents

were required to generalize regularly on the current tendencies of their business, however small, stated under a few conventional heads. Not only would it be healthy in its effects upon them, but would tend to give more reliable results and greater effectiveness to the statistics worked out in the office. Should the generalization of the month's business, made by each agent from current knowledge of the business and not from any figures furnished to him, not correspond with what our figures show, we have at once an indication of how well he is informed and alert to the conditions of his business and what he is doing.

11. Time is unavoidably a most essential element in traffic statistics, and the reason why they are generally of so little value practically. Except on roads of very long hauls, or a great body of solid billing, there is no reason why working statistics fully elaborated should not be in hand of the traffic manager, and the whole line of his subordinates by the sixth of the month following the business they report, or, at the latest, by the tenth. The training of most of the men who compile the statistics of railroads is that of the bookkeeper, and unless their figures are finally balanced and audited they will not let them go out. The elaborate statistical statements gotten out on some roads, sixty to seventy days late, are most disappointing.

12. Tonnage is the form of quick traffic statistics. Gross freight revenue should be shown in connection with larger totals and in the statistics which are not so immediately necessary. Where possible, it is well to show it in connection with interchange with connections. Most roads have a daily-earnings statement. But for the most part we believe the importance of the gross revenue, to the traffic man, as a statistical item to guide him from day to day, is much overestimated. It is important in affecting matters of

general policy, and, to the higher official, is a check on the traffic man. But its full significance can only be brought out in connection with the ton mile, and this is not the day-to-day guide in getting business. The plan on some roads of prorating the daily-earnings statement over the subdivisions at interest is most inexcusable. It conveys absolutely no information that determines the action of the traffic department, and therefore is most worthless. The tonnage forwarded, or the revenue on the tonnage forwarded, from each division is quite a different matter. This shows how far each division is holding its own among those conditions which it controls.

WATCHING EXPENSES.

1. For the purpose of an intelligent criticism, a managing officer needs a tabulated return of expenses differing in many respects from the accounts which are kept for the purpose of ascertaining the net earnings. The expense returns should be made to him in such a form as to admit of minute, critical examination at the shortest possible intervals. It is vital that the figures be fresh, and not ancient history, for the object of the examination is to find out faults and remedy them at once. For this purpose a shorter period than one month gives little information to the general officer. The accountant in these tabulations must not allow the operations of one month to overlap into another. He may with entire propriety apportion, on his books, any one expense item to several months' expenses, but the managing officer, for the purposes of his monthly examination, does not want these generalizations. He wants only the present facts. His total figures may not be the same as the audited expenses of the road for any one month, but in a year or more the discrepancies will disappear, because the actual expenses, as returned to him, will ultimately get into the regular accounts. Hence it is vital that all the actual outlay for operation in any one month be vouchered in that month. Nevertheless, this cannot quite be done, because some expenses, such as damages and accidents, require a long period for exact ascertainment. These should be estimated on the basis of actual accidents each month.

2. The distinction between expenses for passenger

service and freight service or between different operating divisions should be made only when it actually exists. No such distinction should be arbitrarily made by prorating an undistributable charge, as this would be assuming what we wish to find out.

In the transportation expenses, where practicable, the line of road and the terminal charges under each head should be kept separate. On the line, one man does several kinds of work, and his wages are more or less a fixed charge, which may not have any reference to the current volume of business, while at the terminals and large stations, the work is highly organized, and by adjusting the size of the staff to the business, each man's time can be fully employed. The large terminal points call for more careful watching from month to month than the line-of-road. In all of the expense accounts a constant effort should be made to distinguish between fixed expenses (not materially varying with the passenger and freight service rendered during the month), and the variable expenses, which are somewhat proportional to the service rendered.

3. The expenses due to conducting transportation should quite accurately reflect the volume of business done. The central figure is train movement. The train mile is the general unit, and the ton mile is the more exact unit. Ton handled is a station expense unit. The cost of train movement includes those variable expenses which are special for each train, and which would not have been incurred if that train had not run. It includes, next, those somewhat variable expenses which are due to running all the trains. There are also expenses that are only partially due to the entire actual train movement. The form of monthly return for the managing officer's study for the purpose of reducing expenses need not vary materially on different roads, although the local condi-

tions will suggest many additions to and subtractions from the suggested items.

4. It is assumed that the officer will also be furnished with full reports of work done in train movement and in train mile, ton mile, and passengers, express and mail carried, in order that he make his own comparisons of variable and fixed expenses with units of work done.

Conducting Transportation.

1. Train Movement.
   - Line of Road..... (a) Train and Engine Service.
     (b) Delayed Time.
     (c) Train Expense.
     (d) Engine Expense.
     (e) Water Supply.
   - Terminal..... (f) Roundhouse Expense.
     (g) Switching Expense.
     (h) Yardmasters, Roundhouse Superintendence, Watchmen.
2. Local Expense.
   - Line of Road..... (a) Station Service.
     (b) Station Expense.
     (c) Telegraph Expense.
   - Terminal..... (d) Station Service.
     (e) Station Expense.
     (f) Telegraph Service and Expense.
3. Contingencies.
   - Loss and Damage to (a) Property.
     (b) Stock.
     (c) Baggage.
     (d) Freight.
     (e) Persons.
     (f) Clearing Wrecks.
     (g) Repairing Wrecked Cars and Engines.
     (h) Miscellaneous.
4. Rent of Facilities not Owned.
   - (a) Passenger Car Mileage.
   - (b) Freight Car Mileage.
   - (c) Engine Hire.
   - (d) Terminals.
   - (e) Rental of Buildings for Transportation Purposes.
5. Superintendence, Transportation.
   - (a) Labor.
   - (b) Personal Expenses.
   - (c) Stationery, supplies, and other expenses.

6. Securing the Business.
   (a) Superintendence.
      Salaries.
      Personal Expenses.
   (b) General Freight Office.
      Salaries.
      Office Expenses, including stationery.
   (c) Outside Agencies.
      Salaries.
      Expenses (including rent and all supplies).
   (d) Commissions.
      Passenger.
      Freight.
   (e) Competitive Switching, Store Door Delivery, etc.
   (f) Dining Car Expense—net debit.

5. 1-a. Train and Engine Service.—Separate this into passenger and freight, and place the road mileage against it. If the local freight is any considerable part of the whole mileage, it should also appear separately, or else an allowance on some constructive basis should be made for way switching. Run over the charge carefully by divisions. Perhaps a superintendent has arranged his runs badly, so that a man gets a full day's pay for less than a day's work. Some superintendent may be able to double-head profitably and save an extra train crew, while another will not be running his engines up to their full ratings. If at any time there has been a radical change in the basis of pay of either the trainmen or enginemen, or the schedule admits of any uncertainty according to varying conditions, it may be well to separate these two classes for special examination. But for ordinary purposes they should be united in one item.

6. 1-b. Delayed Time.—There need be no distinction between passenger and freight. It should be placed against the total mileage made. This expense is a direct reflection on the superintendent, or else it is due to some general cause which he must be in position to locate. It indicates that the dispatchers

have not been getting their trains over the road as they should, or the fault may be charged to the motive power being in bad condition; or the traffic is too heavy for the facilities and the passing sidings; or, in order to save in telegraph expense, there are not enough of train order points, at least at night.

7. 1-c. Train Expense is, next to engine expense, a large item that should be most carefully watched. For any intelligent information on the subject, the heading should be further classified into heating, lighting, oiling, icing and watering, cleaning, fixtures, tools, etc. These items should bear a definite relation to miles each season. They are the expenses which a loose management ignores. One reason for the laxity is the fact that a considerable part of this expense is incurred by sleepers and coaches in through service, for which settlement is made through a clearing house, involving a delay of two or three months, thus making the judgments on current expense impossible. We remember being called upon to explain a large increase in this account, which had much fretted the transportation department, and, after all sorts of explanations that could not be made to fit, the trouble was found in methods of a clearing house in another city. But such conditions are unnecessary. Besides showing the charges in money, the quantities should also appear. The irregularity of the practice of heating by stove or steam from the engine will tend to make the item "heating" uncertain. Icing refrigerators may be placed against the loaded refrigerator car miles. Cleaning coaches and sleepers, according to the practice of the road, can be divided into two or more kinds of cleaning, as is already the practice in several clearing-house settlements. The cost of each kind of car cleaned will be a fair index to the economy practiced. Oiling and inspecting should be shown against the number of freight and passenger cars handled re-

spectively. Links and pins are a fruitful source of expense, though mainly about the yards where we also have provision for them. Fixtures for fire protection, wrecking tools, interior car fittings, etc., should be shown by passenger and freight service separately. They should run at about a normal figure, except at times of special renewals or innovation of new types.

8. 1-d. Engine Expense.—There is perhaps no other single item of expense that will so well repay careful watching. Any road properly managed will have an engine performance sheet, and its footings should be at hand for explanation of the monthly coal consumption. The principal item of expense, fuel, may have come from different sources, or have sustained different periods of exposure to the weather, and be radically different in steaming qualities. If this be so, it is highly desirable to separate it into two or three grades roughly, and show the mileage against each kind. An appreciable general cause for variation in the coal consumption is the weather. Some authorities estimate it at one per cent. for each 2° variation in the temperature. With due consideration of these general causes we should go carefully over the showing by each division. Delayed time and poor firing and poor running are the great sources of extravagance, and a careful study of the performance sheet will make clear where the fault lies.

9. 1-e. Line of road water supply should not reflect to any great extent the current volume of business unless it happens that the road relies on municipal or other supplies, for which it pays by measure. Regular pumpers on wages should be kept apart from other supply costs.

10. 1-f. Roundhouse expense should include all the current expenses about the roundhouse, which are for the benefit of the engine, exclusive of the superintendent or roundhouse foreman, if on a fixed salary,

and also exclusive of engine repairs. It will then have a definite relation to mileage for the whole road. But for single points, because the length of runs may differ, especially if the system has a large number of branch lines, the unit should be "engines handled." Exactly what will be the definition of *engines handled* must be worked out by the motive power department. Some engines will be wiped, dumped, and washed out, turned and packed, while others may only be turned, so that any unit devised will at best be rude.

11. 1-g. Switching expense includes the cost of switchmen and yard engineers and firemen. It should embrace all the labor and supplies of current consumption, including links and pins used in the switch yard. Switching to repair track should not be included. Note first the ratio of this to freight train mileage. There is an obvious need for some unit of switch work. This is variously had by estimating a switch mile as equal to four, six, eight, or even ten road miles. Sometimes the number of cars handled is used as a basis. Conditions vary so radically at different yards and in the same yard with different train schedules, that it is a matter of great difficulty to settle on any one satisfactory unit. Whatever the unit in use, we may place against it the items of engine costs to judge whether they are high or low. Where there is a regular yard master who gives his time largely to superintendence, his salary and expenses should be shown apart from the general body of yard expenses, because it is practically a fixed charge. Where single large terminals are under observation, the cost of different kinds of switching, as making up trains, stations, and private siding delivery, should be shown separately, though the division must, to a large degree, be arbitrary and inexact.

12. 1-h. Yardmasters, roundhouse superintendents, and watchmen are the salaried expense at terminals

which has no month-to-month relation to the volume of business. It should be checked up periodically. If, from any peculiar circumstances, these officers incur any particular expense for stationery or telephones, etc., it might be well to withdraw such charges from roundhouse and switching expense and watch them.

13. 2-a. Line of road station service should not vary from month to month unless the road has some particular commodity, as the cotton or wheat crop, whose movement is congested at one particular season, and such congestion is general over the entire line. To provide for such possible expansions on roads where they occur, the service should be split up into agents and clerks and laborers, where clerks and laborers are additional men. This will show at any time whether there has been an increase in the permanent staff, which is the important thing.

14. 2-b. Line of road station expense is all the current expense of the station outside of the payroll. Thus it will include stationery and all supplies. It should be practically a fixed charge according to the season of the year. Being a practically fixed charge, it should be periodically checked over most carefully.

15. 2-c. Line of road telegraph expense includes only those expenses that are incurred for the telegraph exclusively. The salary of agents who are also operators should not be charged to this item, unless it be that they are only nominally agents, when their entire expense should be placed here and no part of it charged to station agents. This charge will not show great variations, except upon changes in the rates paid, or irregularity in the number of night offices, or radical changes in the methods of moving the business.

16. 2-d. Terminal station service expenses are almost as largely within control as the terminal costs of trains. In scrutinizing them closely, the expense of agent, chief clerk, and cashier should be first with-

drawn, and the balance separated into clerical and labor costs. The labor should show the expense of transferring, separate from the rest of the work. Against the clerical costs we may place the waybills made, and against the labor the tonnage L. C. L., the solid cars, the stock cars, and the cars transferred or "worked." There will still be other miscellaneous items, but these can be bulked.

17. 2-e. Terminal station expense corresponds to the same charge for line of road stations, except that it should more closely conform to the volume of business.

18. 2-f. Terminal telegraph expense should be separated into dispatchers and operators, the former being those who are permanently necessary for train movement, and the latter being those who may be taken off or put on according to the volume of business. On roads keeping a record of the number of words to each message, there is always at hand a measure of the operator's work. If this is not done we may take the number of messages received and sent. It is true there are times when the wires are burdened and operators cannot "get in," but in the long run such a unit is an approximate measure of the work done by operators. Dispatching is a high order of service, and, as such, must be considered a staff service, not to be directly placed against current result units.

19. 3. Contingencies.—These are the irregular variations from the normal way of doing things, which for the most part are called accidents. By withdrawing them to an item by themselves we are able to probe them to the bottom. The ultimate measure of an accident is its cost in money. This, of course, cannot be had for any monthly statement. We will assume that the figure we have is an estimate of the department charged with finally settling for the claims arising in this month. This is the nearest money equivalent of that form of expense that can be had. Exam-

ine it by comparison with the average monthly figure deduced from some long period, as a year. It must be an estimate of the money cost of the accidents, not of the number of such accidents, for that is the actual fact which we want to know definitely. By property is meant all property not in the hands of the railroad for transportation, excluding stock for which a special item is provided. Repairing wrecked cars is withdrawn from the regular car repairs charge, because it is an extraordinary expense, resulting directly from irregular work of the transportation department.

20. 4. Rent of Facilities Not Owned.—This is a fixed variation from type or from the normal way of doing a thing. It is occasioned by defect in the property, or insufficient facilities. It will include rent of buildings, terminals, or equipment. Take care that the rent for buildings and terminals shows no increase whatever. If any rents are paid on other than a calendar basis, withdraw them and watch them by themselves. Hire of equipment, either on mileage or rental basis, should not increase without explanation. That it has increased, does not necessarily imply extravagance, for the causes may be a lack of equipment or special reasons, having their effect in other accounts. One special reason may be the saving in the expense of transferring freight.

21. 5. Superintendence is closely allied to the foregoing account, because of its nature as a practically fixed charge. This item depends on the general policy of the road, and cannot well be measured against anything but itself in other periods. It may be well to separate it to superintendents, trainmasters, and their clerks. Their expenses, supplies, stationery, etc., however, should be kept separately.

22. 6. Traffic.—The cost of securing business is one remove further from the costs that are directly affected by the volume of current business. In fact, it may

sometimes be policy to invest more money in soliciting when the traffic is lightest. Such an item is "outside agencies." Competitive switching is what the road pays to get business that could not otherwise be had. The amount paid is not within control from month to month, but is dependent on the volume of business offered. Commissions are of the same general nature, except that the rate paid may be within control. Therefore, increases in these items may be noted as explaining increases in the total expense, but they cannot themselves be explained except as indexes to desirable increase of business. Outside agencies differ in this respect that their relation to the business secured is not a fixed thing. It may be grossly high, either through impolicy of bidding so high for business, or the lax administration of the agencies themselves. Its increases call for explanation. Closely allied with this is the deficit from dining-car operations. These operations should bear not only the direct expense of victualling, manning, and cleaning, but also the indirect expense of repairs, oiling, and inspecting, car hire, etc. They represent a definite outlay to secure the business and their expenses in all propriety are a traffic expense. Their net earnings should be placed in the general revenue of the road. Of the same general nature is extraordinary service, such as store-door delivery at competitive points, mileage paid for the use of unusual types of cars as a traffic consideration, nominal demurrage charges remitted, etc. The traffic department should not escape these expenses because they have gone to swell the charges to the transportation department in the regular accounts. Bonuses, small gratuities, management expenses, etc., incidental to fostering the business should be shown under a separate head.

Maintenance of Equipment.

23.

1. Locomotive Repairs.
   - (a) Ordinary.
   - (b) Extraordinary—overhauling.
   - (c) Accident.*
2. Repairs of Cars.
   - (a) Passenger, ordinary.
   - (b) " extraordinary—renewal.
   - (c) " accident.*
   - (d) Freight, ordinary.
   - (e) " extraordinary—renewal.
   - (f) " accident.*
3. Tools and Machinery.
   - (a) Current Repairs.
   - (b) Extraordinary Repairs—renewals.
4. Stationery and Printing and Other Expense.
5. Superintendence.

Maintenance of Equipment is theoretically regulated by the rate of wear or use, but also in a considerable degree by the rate of renewal. For that reason the amount of the expense will be largely determined by the standard of maintenance.

24. ME-1. Locomotive Repairs possibly show a decrease for all services. It may be passenger and switch mileage are unusually heavy and freight is light, but the cost per mile for each service is high. Thus we have located a fault that had otherwise escaped attention altogether. But now let us compare the renewal expense, and we find it unusually heavy and also the repairs due to accident are heavy, therefore we know that our ordinary repairs were cheaper this month. Roughly, we may say that our shop work was economical, but our transportation was careless and we have been bringing up the general standard of our motive power. It is well to keep track of this overhauling charge to see that it is not made the dump for other charges. By showing against the charge for

* The statement being merely a memorandum of items, the duplication of figures for accident repairs is not improper.

overhauling the number overhauled at each shop in periods of six months or a year, we may judge what shops are doing their work extravagantly. If we take our entire repair cost per engine mile annually, we can judge fairly of the real cost of engine repairs, because during so long a period there must be an average maintenance of standard. The engine mile is used as the basis for measuring our cost, and this will be fairly reliable so long as each service is kept separate.

25. ME-2. Repairs of Cars.—Passenger and freight cars should be kept separate, because they are entirely different things, outside of the fact that they contribute to revenue in different ways. These costs should likewise be examined as current repairs, overhauling, and accident repairs. The distinctions as before must be inexact, but they afford information immeasurably better than none at all. If the expense of repairs of different kinds of freight cars is known to differ widely, it is well to keep them separate. Next to maintenance of way charges, car repairs can fluctuate most violently, according as the standard is maintained or let fall. Therefore, it is an exceedingly difficult account to judge. The number of cars overhauled should be placed against the cost, and over considerable periods of time, examined by different divisions and shops to see where the poor work is being done. Current repair cost per car mile is a partial index to the way cars are handled in yards, while accident repairs are chargeable directly to the transportation department. In order to note negligence, accident repairs should be noted against the division where the accident occurred. Bad handling about yards, resulting in minor damages to the cars, should be watched by a report of the number of such accidents, classified rudely at each large yard, although the cost of repairs could not be shown.

As the body of equipment gets old, the expense for

car repairs per mile tends to become high. Also we must have an eye to the average car performance for the month. If cars are lying idle, or being bumped about terminals, or making short movements, their decreased mileage might not be offset by decrease of repairs.

26. ME-3. Tools and machinery expense is not an easy account to judge of, accurately. From time to time with better methods, the fixed plant of machinery will become larger and consequently its maintenance charge will become larger while the work that is done will be cheaper, because of the greater efficiency. But if very much cannot be made out of these figures at the general office, they are of the greatest use to the mechanical man. Over extended periods they enable him to judge of the efficiency of different types of machines.

27. ME-4. Stationery and Printing and Other Expenses are miscellaneous general charges. They may occasionally be delved into, each item sought out and held to the light in turn, and a judgment formed about how they should run. But regularly, we may hardly do more than see that they keep at about the same figure from month to month, and this should not be large. If the road carries any shop employees' insurance or disburses any gratuities to the shopmen that are not a specific charge to some detail of the work, they should be kept as a separate item.

28. ME-5. Superintendence, like the same charge to other departments, is largely dependent upon general policies and the personality of individuals. Adjustments of organization resulting in increased expense cannot be judged in a single month. But it is very desirable to make periodical examinations into the cost for superintendence and the relative amount of the entire expenditure under this supervision, also to pick out the items which should reflect good or bad manage-

ment. Such items are renewals of engines and running repairs costs of both engines and cars. Reasonably approximate judgments may thus be had as to the expediency of the present scale of salaries.

Maintenance of Way.

29.

1. Repairs of Roadway.
   - (a) Superintendence.
   - (b) Ditching.
   - (c) Ballasting.
   - (d) Filling Trestles.
   - (e) Riprapping.
   - (f) Laying Rail.
   - (g) Replacing Ties.
   - (h) Repairs, snowsheds, etc.
   - (i) Trackwalking.
   - (k) Clearing Weeds.
   - (l) Scaling Cuts and Widening Embankments.
   - (m) Miscellaneous, including surfacing, lining and adjusting, etc.
   - (n) Contingencies—Extraordinary costs, as clearing snow, salting switches, repairing washouts, slides, etc.
2. Renewal of Rails—material... { (a) old by old.
3. Renewal of Ties..... ... { (b) old by new.
   - (a) Main Line Cross Ties.
   - (b) Sidings " "
   - (c) Switch Ties.
4. Repairs and Renewals of Bridges and Culverts.
   - (a) Ordinary.
   - (b) Renewal.
   - (c) Watching and Tending.
   - (d) Extraordinary expense due to contingencies.
5. Repairs and Renewals of Fences, Road Crossings, Signs, etc.
   - (a) Ordinary Repairs, fences.
   - (b) " " road crossings.
   - (c) " " cattle guards.
   - (d) " " overhead bridges.
   - (e) " " miscellaneous.
   - (f) Renewals, fences.
   - (g) " road crossings.
   - (h) " cattle guards.
   - (i) " overhead bridges.
   - (j) Contingencies.

6. Repairs and Renewals of Buildings and Fixtures.
   (a) Ordinary Repairs.
   (b) Renewals, Depots,—Line of Road.
   " " Terminals.
   (c) Renewals, Coal Chutes.
   (d) " Stock Pens.
   (e) Renewals, Water Stations.
   (f) " Miscellaneous Buildings.
   (g) Extraordinary, contingency costs.
7. Repairs and Renewals of Telegraph.
   (a) Current Repairs.
   (b) Tools.
   (c) Renewals, Poles.
   Station Outfits.
   Batteries.
   Wires.
   (d) Contingencies, storms, etc.

30. Maintenance of Way fluctuates not with the rate of wear, but with the rate of renewal, which varies with the season of the year and has no reference to the month to month volume of business. Sometimes, for financial reasons, the amount of expenditure of each month is made to conform rudely to the business done, and in this way to correspond to the earnings. But this conformity is artificial and must always tend to increase the cost of maintenance. However, the volume of business done does determine the required standard for speed and size of trains, and thus the amount of renewal per mile may be measurably determined, although the rate of renewal each month may vary. We compare the gross expense for maintenance against the same charge the same month of the previous year. To arrive at this gross expense, we should include all the costs of every kind for maintenance. These would be engine hire and car hire for all rolling stock used, including interest on first cost, depreciation and maintenance, quite as well as the current costs for train service and train supplies of work trains. So also we should include the interest on first cost and depreciation of steam shovels and other large items that have gone into the capital account, but are

for the use of the maintenance of way and structures. In no other way can we follow the real cost of maintenance of way per mile of road. And the increasing use of larger tools, here, as in all other work, tends to make the direct costs less and less, and so far to vitiate our results for comparison. We look for explanation of the increase or decrease in the number of ties replaced, yards of rail renewed, or yards of ballast laid. Perhaps there will be some large single causes, as washouts, fires, train accidents on bridges or betterments, all of which should be temporarily withdrawn for the purpose of comparison. They should be studied by themselves. Next we must look into the several items in turn.

31. MW-1. Repairs of Roadway.—Superintendence has no relation to the general volume of business and may have no very direct relation to the general volume of maintenance charges. It is a salaried staff representing a certain potential that from month to month may not be proportioned exactly to the need, but in the long run bears a close relation to the volume of work done. It should be watched each month by itself. Increases should be accompanied by explanations, since they cannot be explained by the figures of expense. The line between superintendence and other charges must be in a measure arbitrary, but once drawn must be adhered to. The account should be further divided into ditching, ballasting, filling, trestles, riprapping, laying rail, laying ties, and repairs of snow sheds. The reasonableness of such miscellaneous costs cannot be more than guessed at. They should bear a tolerably uniform proportion among themselves. Attendant considerations of prevailing weather, general standard of maintenance and condition of the road, whether old or new, single or double track, extensions, new policies, or experimental methods must all be at hand to assist in judging of them. Whenever labor is applied ex-

clusively under any one of these heads for renewals, it should be charged to the head to which applied. Against such charges we may set result units, as yards of embankment or ballast or riprap, feet of rail, sets of switch ties, etc. But miscellaneous work, as here raising a low joint, there elevating a curve, surfacing, clearing weeds, scaling cuts, repairs of switches and frogs, should go into miscellaneous items against which we set no quantities of result.

32. MW-2. Renewal of Rails offers no information from month to month, except the cost per ton of rails used and the rate of renewal, preferably in per cent.

MW-3. Renewal of Ties depends also on the rate of renewal, though not to such an extent as in case of rails. The per cent. of renewal should be shown for cross and switch ties separately. New sidings involving new ties should be shown separately. If different kinds of ties are used, they should be shown separately.

33. MW-4. Repairs and Renewals of Bridges and Culverts should be shown, where miscellaneous, by kind of structure. Where a definite replacement or renewal they should be shown by bridge and arch replaced. General costs for superintendence, etc., should be shown separately. Contingencies, as freshets, fires, etc., should be separated. Watching and tending should be a fixed figure and will bear occasional revision. Coal and supplies for drawbridge engines should be an approximately fixed figure. Renewals will be high or low, according to the percentage of each part or kind of bridge renewed, and will be expensive or cheap, according to the cost per unit renewed.

34. MW-5. Repairs and Renewals of Fences, Road Crossings, Signs, etc.—This should not be a large account. It will vary both with the extent and cost of renewals, but also by reason of extensions which are required by County Commissioners. Comparisons of

the gross cost per mile of road, between different sections of the same road or different roads, are unsound, because the requirements are purely local and may vary greatly. Note the rate per unit of work done, the rate of renewal, and of extension.

35. MW-6. Repairs and Renewals of Buildings and Fixtures.—This is a difficult item to form any current judgment on, since the rate of renewal absolutely governs the monthly outlay and the work is of such a miscellaneous nature that units cannot be easily devised. Some judgment of the labor cost may be had by its ratio to the value of feet of lumber used. Further it will vary largely because of the addition of new buildings, as fuel stations, stock pens, switch houses, water stations, watch houses, tool houses, ice houses, etc., that come with the betterment of the property and may not be charged to construction. Apply the distinction Line of Road and Terminal to the renewal of depots. Repairs and Renewals of Docks and Wharves is generally an uncommon account. It should be separated into regular and extraordinary costs.

36. MW-7. Repairs and Renewals of Telegraph.—The cost of repairs and tools should be about the same for each month. Note the renewal of poles, station outfits, batteries and wire, and the units of each renewed. Extraordinary expenses due to storms should be withdrawn from the regular figures and noted by themselves. Charges for superintendence should be the same from month to month.

General Expenses.

37.

1. Salaries of General Officers.
2. Salaries of Clerks and Attendants.
   - (a) Executive Office.
   - (b) Auditor's Office.
   - (c) Purchasing and Supply Department.
   - (d) Treasurer's Office.

3. General Office Expenses and Supplies (including stationery).
   (a) Executive Office.
   (b) Auditor's Office.
   (c) Purchasing and Supply Department.
   (d) Treasurer's Office.
4. General Office, Traveling Expenses, Private Cars, etc.
5. Law Expenses.
   (a) Salaries.
   (b) Expenses.
   (c) Court Fees, legal expenses, etc. (ordinary).
   (d) Extraordinary—special "legal expense."

General Expenses will be from six to ten per cent. of the entire expenses. Most of the items, like the detail charges of superintendence, can only be compared with the same charges at previous periods. We cannot compare them with the general volume of business, except over long periods and then only roughly.

38. GE-1. Salaries of general officers will bear the closest scrutiny at frequent intervals. But the individual plays a large part in this range of outlay—the salary of each man must be judged by itself against his recognized capabilities. The aggregate of salaries which constitutes the total of this expense depends on the plan of organization followed, and cannot well be discussed by the statistician, though he may indicate where through the body of expenses, changes affect other expenses. For monthly examination, nothing more can be done than to see that the salaries remain fixed and explain any differences under the head of differences in the rate of pay, and differences of organization. If through the retirement of senior officers there are promotions, a memorandum of the aggregate of such increases of pay to the individuals should be noted, as it may have some bearing on the scale of salaries maintained.

39. GE-2. Salaries of Clerks and Attendants.—Where in the foregoing account we arranged our outlay by single salaries, we should here classify by de-

partments or offices and watch to see that each has no increases or be ready to explain increases if found. As before, it is well to keep a memorandum of the amount of increases to individuals by promotions and the amount by office reorganization and of the decreases as well. Certain rough memorandum measures of the work in some of the offices may be applied at times to gauge rudely the expenses against the results.

40. GE-3. General Office Expenses and Supplies, including stationery, should be watched with extra care. It should be carried under the head of the several offices incurring it.

Stationery and printing is a considerable item in the department of general expenses. It is an uncertain quantity for the reason that it is affected so greatly by changes in method which come irregularly and the benefit of which accrues to other accounts. The only classification of it is into new and existing forms which would tend to throw the largest irregularities into a subhead. The existing forms should run at about an even figure from month to month, and large items of new forms of stationery should be accompanied by explanations.

41. GE-4. General Office, Traveling Expenses, and Private Cars, etc.—This is not in itself so important an account, but may be an index to larger things. It is an expense that is for a great part within the control of the officer incurring. It is not at all necessary to enforce parsimony, but it imparts a most healthful tone throughout the service to have this form of expense under strict surveillance. Increases requiring explanation can be located against departments and individuals.

42. GE-5. Law Expenses.—The salaried part of this must be examined, to see that there are no unexplained increases. The expenses should be shown separately and the legal expenses, court fees, etc.,

should be a third itemization. The first two items we may watch with tolerable certainty, but legal expenses are very uncertain. They must vary with the volume and nature of the work, which may be very irregular and is not easily measured. These costs may be very diverse, so only they contribute to the same result. For instance, we recall the case of a special train run over to the court town and back through several days to carry witnesses, and the direct expenses of that train were charged to law expense. It is not a bad plan to separate the account to the class of cases to which they belong. In this way we are able to trace dimly some relation between this account and the loss, damage and injury accounts, according as cases are fought or compromised.

WATCHING PASSENGER TRAFFIC.

1. We look out on a great system. Regularly scheduled trains are scurrying hither and yon over mountains and plains, through populous valleys and waste wildernesses, at all rates of speed, with all grades of coaches, filled with all classes of traffic, traveling on all kinds of tickets. A toiling, smiling passenger agent, harassed here for lower rates and better facilities and eagerly offering them there, works on in the great confusion. He deals in human nature, personal whims, luxurious tastes, personal vanities; studying always to please. His commodity is the passenger mile, but there are as many different kinds of passenger miles as there are different kinds of human nature and varying shades of mental constitution. In an economics where human nature is so preponderating a feature, statistics must be used with great caution.

2. Like the freight agent, he indulges a luxurious contempt for expense as some mean thing that has no part in the destiny of a hustler. Earnings is his cry, but he is not so far above the danger of incurring direct loss in his business as his contemporary in the freight department. Here, as there, the principle holds good that no traffic costs more than the direct expense incurred by it, and the other earnings which have been sacrificed elsewhere to give the service here. But the direct expense of handling his business is a larger proportion of the whole expense. His trains must run on fixed schedule whether he has a load for them or not. The question is always before him, Shall he run a particular train? shall he give it a particular speed and grade of car? shall he stop it here or there or omit

all local points altogether, at an express speed. In fact, a large part of his responsibility is to determine what train service he is justified in offering. The smaller the road's operations the fewer options for him to decide among and the less the use of statistics. A road with a single daily passenger service at ordinary speed has no need of train statistics unless the question comes up whether they shall drop to a tri-weekly service or combine it with a mixed service.

3. His problem, as that of the freight official, is how to get and hold the business. His first duty is to classify the traffic according to the conditions that limit his control of it. Competition in passenger traffic is very much the same as the competition in freight traffic on the great lines of travel. The most competitive is that between two gateways where several roads are bidding for the same business. Watch most carefully the interchange with connections, to see if we are getting equivalents for what we give. It is not necessary that the number of passengers exchanged be equal nor that the revenue from each be the same, nor that the passengers be even approximately the same. Strategic conditions enter variously at every junction. It requires a broad knowledge of the whole passenger traffic of the road to judge how valuable a given delivery by a connection may be. Further than that, where two roads exchange business at different points, the business at one point may be sacrificed for a given advantage at another point. In watching interchanges not only is it essential to know the actual number of passengers received at a given gateway, but the significance of this number is increased if we know the per cent. the number we have received bears to the whole dividable business at that point.

4. But the traffic arrangements with connections are more permanent than a day to day understanding. The great competition lies in the business which the

road organizes itself at one terminal for delivery to another common point, not the business that is delivered to it from connections. It should be watched with painstaking care. Between certain important points it will bear watching weekly or even oftener, especially if there is anything feverish about it that looks suspicious. Where possible such competitive business should be stated in per cent. of the whole business handled by all roads interested, between the two points. In this way only may we know whether we are losing or gaining on our competitor. Traffic from points of secondary consideration should be grouped territorially by points of origin. The grouping might well be made to conform to the organization of the traffic department in the field.

5. At longer periods we should pick out the different classes of travel, as tourist, emigrant, home-seeker, deadhead, etc., dividing them up territorially according to origin, to note the tendency in each class. Special movements made on special rates, as State or national assemblies of any kind, should be classified according as they are competitive or not so. They belong to the neutral territory, together with the tourist and other special rates service, which lies between the stable regular business of the road and that outer bound where the further concessions fail to stimulate traffic. It is by constantly expanding the lines by this sort of stimulation that the aggressive passenger agent realizes the highest traffic possibilities out of his territory.

Periodically the solicited and extraordinary business in each territory should be stated in passenger miles and examined in connection with the cost of soliciting and the amount of commissions paid. This is an administrative detail.

6. We have thus far been considering traffic, which is controlled by concessions in the rate. The passen-

ger agent is quite as free in the concessions of train service where there was none before, of luxurious rolling stock, and great speed. Periodically the train earnings should be examined. The average earnings and average passengers per train mile for the whole road or for divisions will be only a general figure. We must go over the whole body of trains individually to see what trains are losing and what are paying. This should be done as often as the option arises to put on or take off trains. Nothing is gained by doing it daily or weekly or even monthly if it is impossible to make changes in the train schedules at those periods. The earnings on the great body of trains must be well above their direct costs, but some trains are not earning as much above their direct costs on one division as they might if they were run on another division. Even further, while the individual train on a certain division may not pay, it does not always follow it must be at once abolished. There may be other considerations, not reckoned in immediate cash returns, which do not appear. Some trains are run to make complete a service in a certain territory, which pays handsomely on certain other trains. This does not, however, at all minimize the value of the statistics which locate the weak trains; from these trains we must look for other considerations than direct cash return.

7. It would be a very foolish policy that insisted on horizontal train earnings for every train over the entire system. Just what, under all the considerations to be discussed, constitutes an equitable apportionment of the train service over a system where the volume of traffic varies widely, is a nice matter for the passenger man to determine.

8. For purposes of rough statistics, especially of interchange with connections, the number of passengers is sufficient data. But for train earnings or for watch-

ing that business which is stimulated by special rates, the earning should be shown per train and per passenger mile, by class of passenger. Daily passenger earnings, like daily freight earnings, have more of a "sentimental" value, as they say on Wall Street, than any reliable significance.

9. The passenger statistics of earnings per passenger, and of mile haul per passenger, have no practical value for current purposes. They explain the conditions under which the traffic man labors, but are not measures of his work from month to month. The very rapid development of the interurban systems of electric railways calls for some recognition in the form of statistics used. This is a peculiar kind of competition, involving conditions of service which the railroad cannot produce. As it constitutes no unimportant factor of competition and is making a constantly growing inroad on commuter train revenue, the part of the business which is in direct competition with electric railways should be kept by itself for special attention.

REDUCING EXPENSES.

1. Managers have in late years had this necessity most forcibly pressed upon them. The order is "retrench." It comes on them as an emergency, with no time to parley. It follows that much retrenchment lacks method. Sometimes they adopt a rule of cutting requisitions in two. A master mechanic needs just sixty feet of belting for his shop engine and the manager reasons that for economy he must cut the requisition in two, and the shop work is delayed for thirty feet of belting. A requisition is made for two cylinders for a wrecked locomotive and only one is allowed, and the locomotive must lie idle until another requisition can be got through. Again there is ordered a progressive or horizontal reduction in salaries. A superintendent cuts off his night operators, without reckoning the over-balancing loss of fuel and the expense and vexation of overdue freight. The order is "cut, cut," and all thought of the complications and delicacy of the great mechanism forsakes the manager. Truly there is no feature of operation that calls for nicer finesse and greater abililty than that of wise retrenchment.

2. Under normal conditions the expenses on the average road will run at about 67 per cent. of the gross earnings. Therefore 1 per cent. of the saving in expense is equal roughly to 2 per cent. increase in net earnings. About one-half of the operating expenses responds directly to volume of business, so that an increase of 1 per cent. in volume of business will increase expenses one-half of two-thirds of the 1 per cent. in-

crease in earnings, leaving a net gain of two-thirds per cent. of the gross earnings. This is equal to the result of 1 per cent. of saving in expense.

3. Nearly 25 per cent. of the entire expenses is determined by the number of freight trains moved. Therefore, if we are able to add two more cars to our freight trains and thereby reduce our train mileage, say 6 per cent., we will be reducing our entire expenses 1.5 per cent., which will increase our net earnings 3 per cent.

4. Retrenchment is of two kinds—that which is real and that which borrows from the future. It cannot be said that there are not times when it is necessary to go to the pawn shop; but it is certain this requires no high order of skill. To the manager, his embankments and cuts, his ties and bridges, rails and buildings are a bank where he has accumulated a usefulness extending well into the future. To these he may go and draw when his credit in the money market is low. Fortunately for his good record, the discount is never computed. Like all borrowing from the future, it is only justified when the emergency is short and the relief measurably certain. Thus he may borrow (*a*) from maintenance of way and structures and maintenance of equipment; (*b*) from employees, by forcing their wage scale slightly below the market and holding it there until demoralization sets in; (*c*) from the patrons of the road, in straining their patience temporarily, by the vexation of less trains, less expedition in handling freight and passengers, perhaps a few less stations.

5. Let us take a concrete case and plot out rudely the possible retrenchment of this kind.

Expenses.

Repairs of Roadway,	.1538
Renewal of Rail,	.0259
Renewal of Ties,	.0398
Bridges and Culverts,	.0336
Fences, Crossings, Signs, Cattle Guards,	.0021
Buildings and Fixtures,	.0164
Docks and Wharves,	.0001
Telegraph,	.00039
Stationery and Printing,	.0002
Other Expenses,	.00001
Total Maintenance of Way,	.2723
Superintendence,	.0070
Repairs Locomotives,	.0578
Repairs Passenger Cars,	.0237
Repairs Freight Cars,	.0575
Repairs Work Cars,	.0020
Repairs Marine Equipment,	.0001
Repairs Shop Machinery and Tools,	.0042
Stationery and Printing,	.0004
Other Expenses,	.0030
Total Maintenance of Equipment,	.1557
Superintendence,	.0248
Engine and Roundhousemen,	.0894
Fuel for Locomotives,	.0907
Water Supply for Locomotives,	.0074
Oil, Tallow, and Waste for Locomotives,	.0042
Other Supplies for Locomotives,	.0022
Train Service,	.0639
Train Supplies and Expenses,	.0196
Switchmen, Flagmen, and Watchmen,	.0285
Telegraph Expenses,	.0259
Station Services,	.0673
Station Supplies,	.0072
Switching Charges,	.0052
Hire of Equipment,	.0011
Car Mileage—Balance,	.0154
Loss and Damages,	.0137
Injuries to Persons,	.0136
Clearing Wrecks,	.0013
Operating Marine Equipment,	.0002
Advertising,	.0038
Outside Agencies,	.0197
Rent of Tracks, Yards, and Terminals,	.0050
Rent of Buildings and other Property,	.0023
Stationery and Printing,	.0116
Other Expenses,	.0044
Total of Conducting Transportation,	.5284

Salaries of General Officers,	.0085
Salaries of Clerks and Attendants,	.0126
General Office Expenses and Supplies,	.0026
Insurance,	.0056
Law Expenses,	.0095
Stationery and Printing (General Offices),	.0027
Other Expenses,	.0021
Total General Expenses,	.0436

Résume.

M. of W.,	.2723%
M. of E.,	.1557%
C. T.,	.5284%
G. E.,	.0436%
Total,	100.00%

The percentages of the various expenses here given are of a road that is maintained up to a high standard. The maintenance of way expense is unusually heavy. In estimating the possible saving on each item by the several methods of retrenchment we must not be understood to give any final figures, but rather to show how such estimates of savings are made.

6. From maintenance of way and structures the manager may borrow on great stress, if his road at the outset is in good condition, an amount equal to 15 to 20 per cent. of his entire expenses for six months. From maintenance of equipment he may borrow 5 per cent. to 8 per cent. for the same length of time, if his rolling stock is in good condition at the outset. On the labor that is left in the maintenance department he may make a 10 per cent. reduction, which altogether might amount to almost 1 per cent. of the whole expenses. He might curtail his passenger train movement 10 per cent., which would make a saving of about 1 per cent. of the whole expenses on roads where the passenger mileage is about one-half of the freight mileage. By a 10 per cent. reduction in wages and salaries of the transportation and general administration departments he may save still further 3 per

cent. Thus from all of these sources he could borrow an amount equal to 25 per cent. to 30 per cent. of his entire expenses for six months. But how heavy may be the rate of discount on this promiscuous borrowing is another matter.

7. But there is a retrenchment that is real. This sort of retrenchment does not begin at any particular time nor at any particular point, but should be going on all the time and everywhere. It is by the substitution of new methods and new tools, new men and new material wherever they avail to produce an economy. Some economies are simply by rearranging the order of existing methods or introducing new methods. Others involve the outlay of fixed investment in a tool or plant where there was none or a better or a different tool or a larger plant. There are alternative ways of doing everything.

8. Is it cheaper to transfer freight cars at the junction than to pay mileage on foreign cars in which freight is delivered to us? This is a very simple case. On the one hand we may take the cost of transferring leading lines of through freight and divide it by twice the car mileage rate, and we have the number of miles haul at which it becomes profitable to transfer a car. In case the balance of car movement is in the return direction, we may profitably allow the car to go twice as far.

9. Or take the mooted question whether we shall "pay off" by pay car or pay check. On the one hand we know our pay-car miles, their cost in oil and waste, interest on first cost and depreciation, car repairs per mile, the expense of the paymaster and attendants, and the special train's cost for engineer and fireman, and train supplies. There will be necessary interference with the work of all the men along the line. Especially is this true of the roadway department, and too often in a large measure of the mechanical depart-

ment. This we can take at an estimated figure, compiled from the estimates of the heads of the department involved. Against this we will place the clerical labor of writing pay checks, the stationery and the internal revenue tax, bank exchange, chance of forgery, and any extra charges for rent and office service.

10. From these figures we must be able to form a very correct judgment. So we may lead up to a more difficult question. The management have lately permitted passengers to ride on all freight trains. Can we justify this new policy by increased earnings or reduced expenses? At local points we may be sure that there could be no increase of business. But it might be well to examine a few competitive points, peculiarly situated, so that the use of freight trains for passengers enables us to offer greater facilities than our competitor on a limited part of the road. If we know an increase of revenue at these points, and have no information of any other special causes, we may fairly set down a slight increase to the use of freight trains. The great feature of advantage, if any, is going to be in a reduction of the number of passenger trains, or the saving of an increase in this expense that had otherwise been necessary. This is a matter of specific information in each particular case, and such information should be collated. The train miles thus saved should be compiled, and the estimated saving by this reduction in passenger train miles should be put to the credit of freight trains hauling passengers. To the regular direct cost should be added the personal injury risk thereby reduced, extended by estimate on the basis of the passenger miles saved. Turning now to the special expense of the new policy, estimate the loss by failure to collect revenue, owing to the irregular conditions under which some of our passenger service is now conducted. Take the figures of actual damages paid for personal injury, incurred on freight

trains. To the increased cost of conductors' stationery and the direct maintenance and running cost of the special coach, if anything more than the original shanty car is provided, add the increased train costs due to hauling such coach. Further, in practice it would be found that there was much inconvenience and consequent expense in bringing our freight trains to a standstill so as to place the coach or shanty opposite the platform at way stations, so that passengers could alight at the depot. This would enter as no inconsiderable factor in affecting the cost of coal consumption and wear of brake shoes, etc. Out of these data we have the basis for judging whether the carrying of passengers on freight trains is a good policy in direct measure of dollars and cents. There is nothing new about this. It is simply the enumeration and logical arrangement of exact facts, proximate facts and detailed judgments, accurately. Some of the data can be had from regular figures, others from detailed estimates, and others still from formulæ deduced from careful experiments. It is only necessary to know what we want, where to get and how to apply it, and our result is as much more certain than the usual judgment or "impression" as our method has been more careful and exact.

11. There can be no regularity in the inquiries. They will come up at all times, suggested by some chance view of an existing method or often by fortuitious combinations of circumstances. But the large lines of cost, or those having violent fluctuations that cannot be controlled, will engage the attention most, to discover some other means that can be advantageously substituted. A railroad that is paying seven dollars per ton for coal can afford to be at large expense for special type of fire-box, compound locomotives, and the supervision and training of firemen. If the life of a tie is low, the cost and operation of a creosote

plant is suggested. The relative merit under actual working conditions of the different methods of lighting or heating coaches comes up. If the cost per mile of our train service and engine service is permanently high we may not improperly look into the question whether our terminals are so placed as to give the proper length to our train runs. Are there advantages in the location of our shops or our general offices at a particular point that can be reckoned in dollars? Would there be advantage in the use of larger tank capacity on our engine tenders so that we might concentrate our water supply? Would a given outlay in fencing right of way be justified by a reduced cost for stock killed and decreased risk of derailment? Or could we spend to advantage the damages now assessed against us for destruction of property by fires originating on the right of way, in the introduction of an effective spark arrester?

12. Such are only samples of the inquiries which the most casual view would suggest. The far greater number of suggestions for inquiry would come from those who are doing the actual work. They might want to know the economy of the more general use of pneumatic power about the shops, or of better terminal facilities for handling engines, more convenient yards for marshaling trains, the justified outlay for pipes and pumping machinery by which to charge freight trains with air direct without drawing on the locomotive before starting. The transportation official puts on an inspector of oil boxes and he wants the data to know how far this extra outlay has been repaid in reduced cost for oil and waste, cars; or he questions whether in his freight movements he is spending too much to break bulk in order to increase the tonnage performance of his cars; or he claims that he is losing more money in delayed time than would be the cost of the passing tracks which he deems neces-

sary to move his business. One of his larger stations is at large expense for gas; at the same place, the mechanical department perhaps pays some outside company or the municipality a high price for water. What would be the cost of the engine, dynamo, and pump, and their operation, by which he could do this service for himself? At one of his very large transfer points the facilities are very inadequate. Perhaps some of his trucking distances are a hundred yards, the platform is uneven, making possible truck loads small. He has one or two great leading lines of freight to handle at that point. What will be the expense for better arrangement of tracks and transfer platforms, smoother floors, having inclination in the direction in which the loaded trucks move, and of any special devices of mechanical carriers for those leading lines of freight that come to him in uniform packing and size? As against this, what would be the economy over present methods of the use of such devices?

13. Those changes that involve an outlay in a better tool or larger plant (and most desirable changes of method are of this kind) require the use of additional capital which must for various lengths of time be locked up in this form of investment, before it can be returned in shape of economies. Some such investments can be turned over in one or two years, while others may require an indefinite length of time to wipe themselves out. Not all forms of change that produce an economy are advisable when there are others that will yield a larger per cent. of return, which are neglected. Not only is it important that every department be alert to discover new methods that shall prove economies, but they must further discriminate and bring them forward in the order of their relative economy, beginning with those that produce the greatest saving.

14. This calls for the highest kind of talent. It is the kind which the road may well foster. As a stimulus to its exercise a road would do well to set aside a general betterment working fund, and apportion it to its several departments. Each department could draw on this up to its quota, for those betterments that promised the greatest economies. On the basis of periodical statistical investigations, credits could be given for the approximate amount of the economies thus made, and as fast as each department extinguished its loan for one investment it would be at liberty to apply the amount returned in another investment. The freedom to each department to draw on some such working fund, under proper restrictions, and the ability to roll up a large surplus to its credit, would prove a marvelous stimulus throughout the service.

15. So far we have discussed only retrenchment of the expenses of a fixed standard and amount of service. There is still a legitimate form of real retrenchment, in cutting off those parts of the service given to the public which do not pay their direct expense, and those other parts of the service which do not return as great a profit over the direct expense as some parts of the service would do, which are neglected. Except to compute the amount of the actual cost of each kind of service under normal conditions, the whole matter is in the province of the traffic official, which has been dealt with under the head of watching earnings. Until a part of the service actually earns less than its direct cost it produces a net revenue, however small, that is discussed on entirely different principles than an expense, as it is amenable to entirely different laws. But in order to know whether a given service does have net proceeds above its actual cost, it is vital to know what is that cost.

16. Retrenchment is accomplished by abolition, substitution, and rearrangement of the parts that go into

a whole. We must be able to state the cost of any part of operation independent of the rest, or to measure the effect upon cost of any single condition or group of conditions in order to withdraw parts of the work at pleasure, to abolish some conditions, to rearrange or substitute others, and to do it all advisedly. Where all the effect of a condition or group of conditions is absorbed at a single point in the operations, or where any one part of the work is quite distinct and separable from the rest, the problem is quite simple. We have but to trace and measure the effects of our conditions on a single result. But most of our operations are not a loose aggregation of independent parts, but a highly organized union into a general whole, which responds sensitively to effect produced on any part. When work is done regularly, it is after some regular standards, and the effect of one part of the work upon any other part is always about the same. If we are to do it in a different way we change one or more of these standards or types of work with which it has stood in a fixed relation. Thus if we use a heavier locomotive in order to increase the size of our trains we must have a heavier rail, heavier bridges, and perhaps a better roadbed. If the different way or method has not come about through our agency, but through natural causes that have gradually altered the conditions under which the work is done, or accidental or temporary causes have changed these conditions, the result is yet the same. In stating the effect upon cost of a particular element or condition, not only do we want the direct immediate cost, but also the effect upon cost through all the indirect and remote consequences at other places, arising from the intimate relation of all the parts of operation, which is disturbed when the type of any single part is disturbed.

17. Any method is economical until we know of some cheaper way, when it becomes wasteful. All

work may sometimes be under conditions that are known to be wrong, and practically in any work wrong conditions will always be present in greater or less degree. When a thing is done right it is done according to an existing standard or type, beginning with certain generally normal conditions and producing a result that is generally the same in kind and degree. When any wrong condition enters or when our result is deficient, what we conceive as typical has been disturbed. The element that enters to disturb what our general practice makes typical is the off-type feature of operation. The work must be charged to the regular description of its expense, whether good or faulty, but there should appear with this charge a memorandum of such peculiar off-type conditions as made it excessive. These conditions are apparent at the time and place where the work is done, but are lost when the expense has been charged out to a regular account. In all regular statistical first data should be provision for "remarks," where might be noted the modifying conditions that enter into the regular charge. There are also parts of the work where not only are off-type conditions definitely known to affect the cost, but at the time and place where they have entered it is possible to measure very closely the amount of this effect. Where this measure cannot be finally exact, it is yet a close approximation to a degree which cannot be had later when the figures have gone into the regular account. Where this is practicable the amount of such real or estimated effect, in the same unit as the actual charge, should be shown in memorandum. For instance, an engine is twenty minutes late—the cause is hot box, ten minutes; waiting for connection, ten minutes. Cars are repaired at shops. The necessity arose out of a wreck due to a defective frog. Likewise the clearing of right of way is explained by the wreck due to the same cause. The road foreman of engines

notices that alkaline water on a certain division is causing much trouble to boilers. He questions the expediency of incurring the expense of a radical change in water supply on that division. Let him call for the expense in memorandum of engine repairs due to the excessive charge for cleaning boilers.

18. The conditions which have entered to produce what we have designated off-types are very irregular and often not easy to foresee. They will be special for each kind of work, and different ones will be under examination at different times, according to the various remedies under discussion. They will be suggested by the actual conditions of practical work. Any attempt to give an outline would be only suggestive. Each department should at any time have a whole set of inquiries on foot to determine the actual effect in time and amount of money, of various conditions or methods of work which they have come to hold in question. All of these items are memoranda and have no part in the regular statistical statements, but to the manager who is alert to produce the best service at the least cost they are vital for periodical examination. When these off-type features of regular work are reduced to their money equivalent we have something to equate with the cost of those conditions which we propose to introduce for remedy.

19. In discussing the cost of any part of operation we must frequently have recourse to formulæ of definite physical laws, carefully worked out by experiment in the laboratory: such as the relation of speed to air resistance, the thermal units of coal, the theoretical tractive power of a locomotive, the resistance due to rolling friction on a straight and level track, the effect in actual foot pounds of each degree of curvature and per cent. of grade, the effect in the life of a rail, produced by a train passing over it, the seizing point of lubricants, etc. Gradually, into

such strictly laboratory formulæ we introduce at average quantities, the factors that enter in practical operation. We approximate a figure that shall represent the cost in wear of brake shoes, for stopping a passenger train of normal weight at normal speed and within normal distance, or the normal cost in coal consumed for starting out the normal freight train from a condition of rest to its normal speed within the usual distance, the normal life of a tie in different kinds of ballast, the mileage life of a freight car wheel or locomotive tire, the normal consumption of a standard oil for cars per car mile, etc.

20. Laboratory tests of material, tools, or designs of construction are extremely important, but they can never be final when so many elements remain to be determined in the whole range of conditions that come to enter in actual work. For instance, a certain kind of waste is found to be excellent in the laboratory, on account of its capillary qualities in conveying oil to the journal of the freight car. It is put in oil boxes on cars in actual use and the lids sealed. A record is taken of its performance and it is later opened and examined. But we put it on the regular box cars that are subject to all kinds of inspection and oiling, many of our oil boxes being without lids, and our cars running in an ore traffic, and the result is far from satisfactory.

21. Not only has the direct efficiency of the particular fuel or design of construction for a particular result to be thought of, but there may often be set up other indirect effects that have not been foreseen. A well-built, 65,000-pound capacity car, theoretically, is a far better transportation tool than one of 40,000 pounds capacity having a much greater ratio of dead to live load. But we operate in a territory where there is much miscellaneous L. C. L. freight, and, as a result, our car in actual use is half loaded or we must

break bulk excessively, and all of the supposed economy of our large car is gone.

22. Thus we begin with the theoretical laboratory conditions, and one by one introduce those of actual practice reckoned at their average quantity. These average quantities must always be at hand to use for this purpose. They are average tons per loaded car, average tons per train, average clerical cost per way-bill, average car repair cost per car mile, etc. Not only do we have to deal with the average cost per unit of result, but also the average usefulness of such results to meet the demand which they supply.

These elements of operation which we introduce, act and react on one another so that some of our final averages, as earnings per train mile, comprehend so many interacting conditions that all degrees of efficiency and inefficiency at single points are covered up, except in the final result.

23. In discussing the comparative cost of two methods, we must be careful never to be misled to consider only the difference in cost per unit of work done. Quite as important as the saving per unit is the aggregate amount of saving, which depends on the volume of such units as occur in the regular work and the permanency of the conditions which give rise to them. Thus any considerable amount spent in improving the station facilities at a transfer or break-bulk point, where the business is light or irregular, would not be justified. The usefulness of a thing, as well as its economy, must enter, in discussing its final economy. It is here where so much of the "figuring" that is done on a railroad becomes unpractical.

EXAMINING EARNINGS PERIODICALLY.

1. This form of investigation is more deliberate and thorough than the mere current watching of earnings. It discusses fundamental policies and ultimate tendencies. It will not be made with any regularity, but will be going on all the time in some part of the field. It should generally be for periods of six months or more as a precaution, that the results may not be invalid. It will be directed in this or that direction, as occasion requires or suspicion points to weak spots on which clear information is needed. From these investigations the traffic man should be able to know whether he is getting out of his great lines of business the maximum profit which they will stand.

2. In getting traffic we go upon the theory that every ton of freight we get or every passenger hauled is so much money earned, regardless of the rate it is paying. Paradoxical as it may seem, this is largely true. We have but to reimburse ourselves for the direct cost of handling this particular business, which is the cost that had not otherwise been incurred, and we are "even" in the transaction. Such cost is so small a part of the great bulk of the expense that our rate must be very low before that point has been passed. The amount of this cost is a thing for the transportation department to regulate, and since most traffic is safely above this point, its discussion does not enter practically into every-day traffic affairs. But there is a consideration in connection with cost which should be examined carefully. A business may reimburse the road for its direct outlay and add a slight profit, but it may be far from a paying business basis. In other words, it is not paying

as much as it ought, which is as much as some other business having an equal direct outlay would pay. A railroad cannot afford to carry any business at a less rate than it can get for the same outlay in handling a different business, which it has sacrificed. This does not mean that it shall charge the same rates on all classes of business. The rates as they stand are supposed to be at that point where a decline will not stimulate the business sufficiently to offset the loss by decreased charges, and where an increase in the charges will decrease the volume so far as to make a loss, greater than the gain by the higher tariff. Different classes of business will respond differently to changes in rates, and the profit on different classes of business, over and above the direct cost of handling, will be very different, according as the original rate is high or low. When a railroad employs its capital and its cars to handle a business upon which the profit, not per unit, but for the entire volume of that business, is less than it would be on some other line of business, if that business had been stimulated to the point of maximum profit, we may be said to be handling the first business at a loss. This is the field for the finesse of the traffic department. They have the discretion to give concessions, in rates and in service, and to further add to the expense of handling the business by the cost of soliciting it. The payment may not always involve money, but may be such a consideration as the interchange of traffic or the sharing of valuable privileges.

3. For purposes of watching the business currently we analyzed our traffic into classes of "getability"; that is, we placed such business in each class as could be controlled by the same considerations. But these classes are at best rude generalizations. They rest on conditions that are constantly changing. In our inquiry we assumed that certain conditions were the

controlling factors and we did not stop to inquire whether this assumption was correct. It becomes necessary to ascertain if we may not have put a commodity into a wrong class, where it enjoys concessions which another commodity or another business would have been able to pay more for by a larger volume. Or we may have had two kinds of business in the same class as far as the rate is concerned, but we devoted ourselves by solicitation and special facilities of service to stimulating one class, when this money could have been applied to vastly greater results elsewhere.

4. Suppose we begin with the gateway business that comes to us by a particular connection. For purposes of currently watching earnings, the tonnage interchange is a fair index; but to form a better judgment of the value of this business extending over long periods, when questions of larger policy are discussed, we should know the ton mileage interchanged. If the rate is very low, it is necessary to know the gross earnings per ton mile on this business. If the business is miscellaneous, resulting in rates that are very irregular, according to points of origin and destination of shipment, or according to certain leading commodities, it may be well to carry the analysis further, so that we may know what general movements through this gateway are dangerously near the dead line of no profit.

5. Business that is paid for by commissions direct is very simple to judge of. It is business that could not otherwise be had, and it is, therefore, cheap at any price short of confiscation of the entire net profit of handling. If it can be had otherwise, the question narrows down to a choice between two or more lines. Then we have but to compare the price of respective commissions per thousand tons together with the ton miles each line is able to command.

6. But that business which is handled by a co-op-

erative line is different, because in large measure its expensiveness depends on its volume. It is a direct outlay which we connect with one class of business, but which we may at pleasure withdraw from that business and devote to another where it may result in greater stimulation. To know whether we are disposing of our outside agency funds to the best advantage, we should at times carefully go over the direct expenses per ton mile of traffic of the various lines to which the road is a party. Some lines will be relatively more profitable than others because of the grade of business which they offer, and with the soliciting expense it would be well to show for comparison the earnings per ton mile of the various lines. By the use of the estimated ton-mile rate of train expense we may, with these figures, be able to tell where we are getting the best returns. Never should we be misled into considering different rates of profit on different kinds of business as an indication of bad management. But it does call for some statement of those "other considerations," which the traffic man must always have in view. Too often these "other considerations" are only vaguely guessed at, and because never definitely stated are overestimated.

7. Turning now to general competitive business secured directly by the road, we want to know practically the same facts of this business as of that which originates off the road. But it will be examined by large single points or groups of secondary competitive points instead of by lines, as in case of the foregoing. However, this difference must be emphasized. This business is in our own territory, where our property is located and fixed. It is not miscellaneous, picked up business, which if we fail to get here we may get elsewhere. But it is business of which, if we fail to get our proper share, we may not be able to make good our loss in another quarter. The examination should be

by leading commodities and groups of movements. For the most part the forwarding station and not the receiving station is the point to be examined more closely.

8. We begin with that class of competition which is due to competing lines and pass over into discussion of the competition of producing points, competing markets, and finally competing commodities. The original line between the competitive and non-competitive traffic in an exhaustive examination becomes extinct. The traffic man is dealing every day with these questions, but they come to him in miscellaneous order, by individual instances, under the pressure of individual interests that are concerned. Statistics must sum up these individual instances into general aggregates and state them accurately, so that the tariff man may have some quantitative notion of their relative significance and bearing on other interests involved. The statistician must have a wider outlook than his own road, or even than transportation itself, in the case of certain of the great lines of commodities which support the road. Industrial processes, methods of moving and marketing staples, as well as their values, are constantly shifting. A new method of baling cotton, an increasing draft of ships, and decay of old methods of lightering cargoes, may disarrange his entire traffic. What they are doing in a competitive territory, that produces commodities the same as our own, is a vital matter for inquiry.

9. The results of the investigation, so far as possible, should be reduced to the simple form of a statement showing tonnage, ton miles, gross earnings, earnings per ton mile, net earnings per ton mile (deducting direct train expense on an estimated basis per ton mile), tonnage exchanged, or other considerations that bear upon and explain the case investigated. If the inquiry is into passenger business, that statement should be after some similar form.

CAR, ENGINE, AND TRAIN, MOVEMENT AND EXPENSE STATISTICS.

1. From the standpoint of transportation, the primary thing is the maximum tonnage movement with the minimum of car and train movement. This will be controlled by the loading and distribution of cars, the performance and expensiveness of locomotives, the care in making up trains. Our examination is to find where and why the empty and light-loaded car mileage and train mileage occur. The summary figure generally used to begin with, is tons per train, on our train mile statement. This is analyzed by reference to our car and engine performance statements. The use of the train mile, however, rests on the assumption that it is an approximately fixed unit of cost. The very extended use of helpers and double-headers has come to make it of doubtful value, unless we compare the helper and freight engine mileage with the train mileage.

2. The special statement of trains should show the train miles, by kind of service, by direction, by main line, by branch line, by mile of road per day or month, as desired; also, the train hours of detention by class of service and division. Train service expense should be shown by kind of train mile, by operating division. Train supplies expense, itemized as heating, lighting, cleaning, oil and waste, links and pins, icing, tools and miscellaneous supplies, should be shown by kind of train mile, in the same way. And finally should be shown the tons and cars per train mile.

This statement should not include costs that are special to the engine, which will be shown on the en-

gine statement, but only those expenses that are general for the train. Train mileage shows the work of the dispatchers, train service, and, in part, of the yard crews.

3. Note the movement by each service and direction and then by divisions in connection with cars per train reduced to a loaded basis. If the former increase and the latter decrease, the showing is bad. Note the detentions by divisions and kind of service. Watch the train service and the supplies on each division. There is no need of itemization of the train service expense, because for most of the road there is a fixed standard of service or complement of men, and a standard rate of pay.

Special Statements.

4. Engine Movement and Expenses.—Most roads undertake to place all of their engine statistics on one monthly "performance sheet." This generally results in a lot of statistics too refined for some purposes and too general for other purposes. Because so elaborate they are often too late to be of any practical use. The purpose of engine statistics is threefold. In the first place we want to watch the performance of engines, next the consumption of supplies, and again to follow the cost of maintenance. These are very distinct from one another in the data required and the form of statement. For watching the consumption of supplies we should have a weekly statement showing the consumption by individual engines. For noting the performance of engines, we should have a statement, by classes of service, by type of engine, by train-masters' jurisdictions. In case the engines are individually rated, the type of engine might be omitted and the performance stated in per cent. of rating. To watch the expense of maintenance, the engines should be classified by types and services, and the exhibit should never be more fre-

quent than once a month. In fact it is doubtful if anything more than a general average cost for all engines is of any value from month to month, because the expense at times depends as largely upon rate of renewal as rate of wear and expensiveness of renewal. Itemized statements of cost of engine maintenance are of far more value every three months than every month.

5. The statistics showing the consumption of supplies could properly be called the engine supplies statement. It should show the consumption in quantities by individual engines and by classes of engines per engine mile or other performance unit. If different grades of coal or waste are used, which have different normal efficiency, their units of quantity cease to have significance. The number of miles run to a pint of all oils has significance only so long as the relative quantities consumed remain the same. In such cases the quantities should be thrown together at their money values. In doing this the current fluctuations in price should be shown in another place, and only the normal average value should be shown on the individual engine statement. For oils and waste it may be questionable if statistics of consumption by individual engines are of great value. The amount of the expense is large in the aggregate, but it can often be better controlled by enforcing a rigid standard of allowance at time of issuing, instead of recording the consumption afterwards. The value of any oil statement is further invalidated by the practice of chain-ganging the crews.

6. The great item of engine supplies is fuel. Too great care cannot be given to keep its consumption within bounds. Since the largest factor in regulating this expense is the way the firing is done and the engine is handled, it is very important that the consumption be charged to the men who run the engine. Under

the old plan of a regular crew to each engine the method of this accounting was very simple—the coal was charged to individual engines. With double crewing of engines this method could still be used, but the responsibility was divided among four men instead of two. With chain-ganging of crews the accounting becomes more intricate. The coal must now be charged to individual enginemen. At the end of runs the coal left on the tender must be estimated and a credit allowed. The engine mileage or other performance unit to be placed against this expense must also be developed by enginemen. In case different kinds of coal are used, they must be shown and developed separately. This greatly complicates the accounting, but is absolutely essential if our statistics are to be of practical value. By judicious mixture of different coals, roads have been known to make savings of $20,000 to $30,000 per month over the use of the same coals used separately.

7. The effort to show all costs against the engines is on wrong principles and can never succeed. Attempts to prorate such costs on approximate bases, only so far assume what we wish to prove and cumber our figures with load that obscure the actual differences we seek to locate. Thus the prorating of water supply costs, superintendence, and stationery and printing to individual engines, or even to classes of engines, brings out no information.

8. Supplies that are not interchangeable in their use should not be shown together. Thus, car oil and valve oil should not be thrown together to show the number of miles run to one pint of oil; nor should kindling wood be consolidated with coal, unit for unit, as is so often done. It would be as reasonable to reckon one ream of paper equal to one ton of anthracite coal, simply because the ream and the ton were units of their respective articles.

9. The time-honored unit for engine costs, namely the engine mile, is open to many objections. For fuel consumption it is a very inaccurate unit. Assuming that one-third of the fuel consumed is chargeable to the engine alone, then two-thirds of the fuel expense depends entirely on the amount of the load, modified by grades, speed, and weather. It is far better to use a work unit devised out of generally accepted formulæ. All the elements entering the formula of work done by the engine, are fixed quantities not subject to change, except the gross weight of train and the weather conditions, and these two elements are now matters of regular record on every well-regulated road. If not thought best to use a scientific work unit, ton miles will serve, provided the different kinds of service and territory having different prevailing grades be kept separately. It is desirable that a definite allowance be made for the engine itself, on some basis to be determined by experiment, and the rest of the fuel consumed be placed against the work units or ton miles made.

It is entirely practicable to watch this expense of fuel for engines with precision, and the importance of the expenditure justifies the closest attention.

10. Engine performance has only recently come to receive the attention which its importance deserves. It has been found entirely practicable to know the actual weight of trains before leaving terminals and throughout the run, and to make up trains on the basis of a theoretical rating of the engines. To obviate the necessity of using a theoretical formula of speed-effect on resistance, we can group our trains by speed conditions into through passenger, local passenger, fast freight, slow freight, local freight. By multiplying their rating by the miles traveled we have the theoretical performance, roughly. Against this we place the actual performance in ton miles. By stating it in per

cent. we have a convenient figure, on the universal scale of one hundred, whose significance can be caught at a glance. Engine performance should be studied by itself. It is too common a practice to very elaborately work up monthly performance sheets on railroads in this country, in which the varying engine performance, which is a thing by itself, is extended and ingeniously exhibited in every variety of combination, as cost per car, per engine, per ton mile, of oil, coal, engineers' and firemen's wages, repairs, etc. Not only are these averages wasted work, but they confuse and cover up the very things we seek to find. Engine performance is distinctly one thing. Rate of consumption of supplies and other engine costs is entirely a different thing. The effects of one should be eliminated from the comparisons of the other.

11. Engine performance is exposed to constantly shifting conditions. It is of the most vital importance that the working statistics by which we direct the handling of our power be instantly available before the mistakes which they bring to light have passed too far to be rectified. Some roads have nothing but a monthly "performance sheet" that is due after the figures have all been carefully audited and certified upon the general books of officialdom. If they were logically devised, they might serve as an interesting guide to investors as to how the property is handled, but they certainly are of no use to a yard master, a train master, a superintendent, or even a general manager, in his immediate business of getting tonnage over the road as expeditiously and cheaply as possible. Beginning with the lowest responsibility we move outwardly, successively eliminating detail and local conditions from the view, until we come to the exhibit for the president. As we go up in the scale of responsibility, action taken must be more deliberate, must contemplate more alternatives, is determined by rules or

general policies that cannot be subjected to instant change. Therefore the information the president requires is not only more general, but also, except possibly for a salient feature which at times is under special observation, it is not of such instant use as the information which the yardmaster or the trainmaster requires.

12. A yardmaster should have a record of each train *while it is being made up,* showing its tonnage rating, the tonnage given it, and the pick-ups and set-offs scheduled for it up to the next terminal. The dispatcher and the trainmaster should have a daily statement of total number of trains, theoretical rating of engines, and actual rating leaving terminals. For *each* train leaving the terminal, light loaded, there should be a full statement of the causes. The adjustment due to pick-ups and set-offs should be roughly calculated in ton miles or other work unit that may be used. The tonnage short of rating, owing to weather or impaired condition of power, or to any other special conditions, should also be stated in the ton miles or other work unit used, and all of these adjustments roughly made should be applied to the actual work done to meet the theoretical working efficiency of the power leaving terminals. Dispatchers and trainmasters should watch these statements daily with extreme care. It should be clearly understood that this record is only a memorandum for immediate current purposes. It is far more important that it be instantly available than closely accurate.

13. The superintendent should have placed before him, once a day at least, a summary of these ton mile adjustments, exhibited by principal terminals and by general causes. In order to relieve the congestion at one point or meet a demand at another point, he may temporarily remit here or modify the rule there to keep the whole machine in working shape. He should have before him a statement of the effect of these ir-

regularities, so that he may judge of their bearing on the ultimate showing for the week or month. The superintendent of transportation should have a general "tonnage report" certainly as often as once a week. It is not only important that it should be weekly but that it should be fresh. A weekly report one week late is no better than a semi-monthly report, and a semi-monthly report two weeks late is no better than a monthly report.

14. Most general managers keep personally informed daily, and even as often as every four hours, of the conditions of terminals and the movements to and from those terminals. The form of statement is largely determined by each official's personal caprice, but to belong to a general system of statement it should express the facts which it is intended to exhibit, in ton miles or other work unit of the road. Thus any information it gives can be related to ultimate exhibits, and the manager can each day intelligently relate the peculiar conditions, with which he has had to contend, with their ultimate effect.

15. The president should have a comprehensive general performance sheet by divisions, starting with the theoretical performance under theoretical conditions, and apportioning the discrepancy between this and the actual work done, among the several general causes that prevailed during the month.

16. The performance of switch engines sometimes will bear more attention than that of road engines, because it is subject to greater fluctuations in the demand. Our road power is busy where the business may be, but the power at terminals is generally assigned there, and if the business suddenly declines as it does at different points in different seasons, the excess power should at once be withdrawn. Perhaps one of the largest leaks on some railroads is in the handling of switch engines. The working conditions

of different terminals and under different traffic conditions, are so diverse that most roads have despaired of any general statement. For this very reason it is not possible here to give any suggested method of stating the performance of switch engines that could be of universal application. In the first place it is possible and highly essential that all idle time over ten minutes should be carefully kept by the engineman of every switch engine, with a memorandum of the cause. If managers could only consider the money cost of those ten minutes added up to aggregates for the system, the record and careful study of the conditions that produce such large costs would not seem so fruitless a thing. These delays are of every variety. Many of them with better arrangements of terminals could be eliminated. After this it is possible for practical yardmen to devise certain units of work that shall serve as an exhibit of what has been done in a yard. The mere statement of "cars handled" is too vague. The different conditions at different yards call for allowances that shall put all yards approximately on the same plane. The use of a constructive rating in miles per hour results in many inconsistencies, and for the most part produces worthless statistics.

17. The performance of work trains, while it interests a different department, is yet of much the same general nature as that of switch engines. It should be stated in much the same way. No single method for measuring work engine performance will serve for all cases. Sometimes it is little better than mere switching, except there is a great deal of time spent in sidings. Again, in case of long hauls, on ballast it is little different from freight service.

18. Engine Maintenance Sheet.—Engine maintenance, like engine performance, must be followed from many different view points. For immediate current supervision, our exhibit must be adapted to show the

progress of the work. Thus it will show the number of engines in the shop, the nature of the work to be done on them related roughly to the shop capacity, as by stating this work in engine pit days. To judge of this work, the number of days already in the shop should also be given. In addition to this the probable rate of shopping engines as an index to the future demands on the shop will be given. This in turn will be supported by a statement, rudely given, of the present condition of the power not yet in the shop. Memorandum reports along this line are kept in one form or another by all superintendents of motive power whose great and constant task is the apportioning of their resources among the different demands of various degree, so that all needs are met evenly. In addition to keeping the power up to standard by repairing the defects in its own construction, and correcting its failure and normal wear, the motive power man must be ready to meet all the fluctuations of traffic and, further, the contingencies of accident through fault of the transportation department. Most superintendents of motive power find it advisable to keep by them a memorandum of the estimated expense of repairs due to accident. When these repairs become excessive such figures serve as off-type statistics to protect him against the irregularities of another department.

19. The maintenance of an individual engine depends on the rate of renewal as well as on the rate of wear. Assuming that the rate of wear is constant because the traffic is stable, the rate of renewal may depend on anything but the calendar, which is made the usual basis of comparisons in these exhibits. It depends on the age period and on the type of the engine, and also on the care and economy with which the work is done at the shop. From this it follows that a monthly statement of the cost of repairs on individual engines is without meaning. The monthly

statement only has significance as we extend the area of observation to include large classes of engines and finally the entire power equipment of the road. If it is accompanied by a memorandum statement of the number of engines in different classes of condition, to serve as an index as to what is the general rate of renewal, our cost of maintenance of all engines per engine mile, then becomes a significant figure. Much the same information can be had if we group our engines by age periods and show the mileage and repairs within these groups. The investor who is examining the reports of a railroad is vitally concerned to know the condition of so large a part of the property as the motive power. This is generally stated as so many engines, with no further information. These engines may be ponies or moguls and new or old. It is highly desirable that the power should be stated, as so many tractive units instead of number of engines, and that these tractive units should be grouped by age periods. Such an exhibit would serve as a rough index to the condition of the power.

20. The mechanical work, under present methods, of gathering and ordering the data for any elaborate statistics has generally deterred roads from a systematic analysis of their engine maintenance expense. The relation between detail, types of construction, and cost of maintenance, is far too undetermined. Until they are willing to use modern methods in the compiling of their statistics, the cost will always deter them from knowing about this expense what should be known, in view of the great amount of money involved.

21. Car Mileage Statements.—A car day represents a definite cost which must be turned to account by ton mile performance. To make ton miles this car day must make car miles and these car miles must be loaded. It is too often customary to begin with the

car mile and leave out of sight the car day. The car mile is a convenient unit of a great body of expense, but if we ignore the relation of the car mile to the car day a very important index of expense is left out of view altogether. However, a reference to the car day is generally had indirectly, in the information of per cent. of car miles on home rails made by foreign equipment. The two things to watch are car movement and car distribution.

22. *Car movement* is shown by car miles per car day. This will be analyzed by divisions. If there are distinct lines of business, as wheat or cotton or coal movement, it will be further analyzed by the kind of car, and home and foreign cars. If the business is subject to violent fluctuations or the detentions are bad, the days of detention under load and waiting load should be shown.

23. *Car distribution* is the nice business of the superintendent of car service. The best distribution makes the least empty mileage, and other conditions being normal, the least foreign car mileage. The index to car distribution, therefore, is in the per cent. of loaded mileage and per cent. of foreign car mileage. If the traffic consists of a few leading lines, it will have a fixed prevalence in one direction. In this direction of prevailing movement the loaded mileage should be nearly 100 per cent. of the whole. The per cent. in the direction of least traffic depends entirely on trade conditions. However, where the traffic is miscellaneous, or consists of large definite movements in both directions, using different kinds of cars, plainly the per cent. of the whole movement loaded in either direction will be low.

Car distribution also affects the per cent. of home and foreign car mileage. The bulk of the interchange is in the box cars. Therefore, if the box car mileage has declined and the foreign car mileage has increased,

we have displaced our own cars to use those of other roads. This may not always be a bad thing. Sometimes it is invariably incident to certain seasons, if the road be an intermediate link of a through line.

Special Statements.—Car Movement and Expense.

24. It is common to express the motive-power costs per car mile, as fuel, engineers and firemen, water supply, oil and waste engines, and other supplies. Such items throughout will be simply the costs originally shown by the engine mile divided by the average number of cars per train. It can convey no added information. It is as if a market woman itemized her costs for harness, horse feed, horse-shoeing, and wagon repair per head of cabbage when she had also shown them per trip. The horse-shoeing per head of cabbage is in no way different from the harness expense per head of cabbage, since it cannot be added to nor withdrawn from the transportation expense of any individual head of cabbage. In other words it is an item of the trip cost and not of the costs per head of cabbage transported.

25. Closely allied with the movement is the loading. Note the tons per loaded car. Locate fault by divisions and kind of car. But tons per car (loaded and empty) is superfluous, since it includes the factor of loaded and empty movement, which is already noted, and so far obscures the actual condition of the loading which we are examining. In comparisons between periods several years apart, our tables will be in part invalidated on most roads by the greater car capacity in recent years.

GENERAL PRINCIPLES OF THE INTERSTATE COMMERCE COMMISSION CLASSIFICATION.

1. The essential thing is an exact figure of *expenses* as distinguished from *construction* charges, and then a general analysis of expenses to show their relation to the earnings; since they are composed of expenditures that variously bear on the earning period to which they are applied. The Interstate Commerce Classification is rather a means of identifying and describing expenses that shall go into the general totals than significant as an exhibit in the itemization.

2. It may be open to criticism in places, but as a whole it represents the best thought on the subject and is by far the most scientific form of analysis of railway operations attempted in any country. In a matter of so much importance and of consequences so far-reaching there is naturally much difference of opinion. With time and ample discussion it will tend toward some common settlement which shall embody the best thought of all. The Statistician of the Interstate Commerce Commission and the Committee of Railway Accountants, while fully aware of some defects conceded and others alleged, very wisely are not disposed to act hastily in making changes.

3. The direct business of a railroad is transportation, and about the movement of trains as a central figure all the other forms of operation are arranged. The expenses naturally will fall into the same arrangement. They begin with those costs that are directly incurred by train movement, and they extend by successive ranges to those costs that have no direct relation to train movement. The best practice breaks

them into four general ranges according to the directness of this relation. The first is conducting transportation, which includes every expense directly incurred for the movement of trains and the terminal handling of freight and passengers. The next is maintenance of equipment, which is the renewal, for wear incurred in train movement. Since repairs may be made irregularly, this expense may have little or no *current* relation to train-miles. After this is maintenance of way, which has only an indirect relation, since the track must be maintained whether the train movement is heavy or light, and since extraordinary costs involved may be due to causes having no connection with trains. Finally there are general expenses, which must be paid, so long as there is a property to care for, even regardless whether trains move or not.

4. An analysis, by these four heads, is essential to explain fluctuation in the net earnings of the property, since so large a proportion of the expenses depends on the rate of renewal and not on the rate of wear.

5. The accounts thus correspond roughly to the four general departments of organization. The underlying theory is that each department meets all the conditions which require its *kind* of work. Thus two or more departments, which may be involved in doing a piece of work, parcel the whole work into different *kinds*. Each *kind* of work on a piece of work is itself considered a piece of work. Each department works up to a certain point and then yields place to another department. The line between is determined by practice, which fixes standards. Thus, at a wreck, the transportation department clear the wreck and settle for the damage with the shippers; the maintenance of way department repair the track, the maintenance of equipment department repair the engine and cars, and the legal department defend the company against lawsuit for damage on account of this wreck.

6. So long as the conditions met by each department are those imposed by operation as a whole, the division is logical. But when the condition met is not imposed from the outside, but is directly due to the negligence or failure of one department resulting in an expense to another department, the apportionment of the expense is unfair. The absurdity of it is obvious in the following case: An engineer ran by his signal. The locomotive rolled down the bank and fell on the passing locomotive of another railroad, damaging its equipment and track, injuring the private car porter, and destroying a car load of company supplies. The company whose property was injured repaired the damage and gave the private car porter a gratuity. It presented a bill to the road at fault for this expense. The latter road charged the cost of repairing the engine to engine repairs, the repairing of the cars to car repairs, the repairing of track to repairs of track, the gratuity to porter to general expenses, the company supplies to store stock.

7. In the case cited the entire expense was due to one department falling away from its standard, due to accident. In addition to this, are the cases where standards change entirely, so that part of the work formerly done by one department, because now done in a different way, is done by another department. In the former case the change of standard was transient and due to contingency; in the latter case it was permanent and deliberate. For the latter, generally, no provision is desirable, but for the former there should be some provision in the classification, when the amounts involved are significant.

8. In addition to the accounts coming within the direct control of operation, is a line of expense that is less flexible but yet does not belong to the wider area of "fixed charges." This expense is taxes. The different kinds of taxes are so various that it is difficult to

group all such expenditure into a single class. The fundamental notion of a tax is its certainty and invariability. Except from the standpoint of the publicist, the deciding consideration that describes taxes is the relation of the taxes expense to the operations of the property. Not the ultimate use of the money collected, but the method of the collection, as related to operating conditions, is the vital factor. The ruling of the Interstate Commerce Commission, that war revenue stamps are "taxes," would justify the charging of postage stamps to the same account. Both are to sustain public service and bear directly on operations on the basis of use.

In the succeeding chapter we have used the Interstate Commerce Classification of expenses. Each item has been taken up in turn and so far as possible the general principles involved have been stated. Considerable difference as to details is still found in practice of different roads, and the interpretations here given are not necessarily universally accepted. A standing committee of the Railway Accountants Association has been constituted as referee in case of disputed questions as they come up in practice. These interpretations are given official force by supplementary bulletins of the Interstate Commerce Commission. In time they will come to completely cover the whole range of uncertainty and reduce variety to uniformity.

MAINTENANCE OF WAY.

I. REPAIRS OF ROADWAY.

This is a very large account, amounting generally to more than half of the entire expense of maintenance of way and structures. It includes everything there is on or in the roadway, except the bridges and culverts, fences, road crossings, signs and cattle guards, buildings and telegraph, and the cost of rail and ties. Thus it embraces all rail fixtures, such as frogs, switches, switch stands, interlocking plants, signals of all kinds, but not the buildings, snow sheds, tunnels, etc. It includes the labor distributing and laying rail and ties. The maintenance is against natural deterioration, weather, weeds, snow, fire, damage by wreck or lawlessness. It is also made to include betterment by ballasting, widening, and protecting slopes, scaling cuts, ditching, lining tunnels, filling trestles, rip-rapping, etc. The labor of taking up, or any other expense incidental to removing something that was once a part of the roadway, is chargeable to the same account as the maintenance would have been, if the thing had not been removed. Costs incidental to the maintenance or betterment of roadway, as outlay for snow fences, dykes, retaining walls, piling, quarry rights (where the land is not purchased outright), gravel pit, sand pit, or other concessions in connection with roadway maintenance; also the cost and maintenance of tools and necessary material and supplies are charged to this account. The current costs for labor and supplies of ditchers, work trains, steam shovels,

and pile drivers, snow plows, boarding cars, etc., are included. But the first cost and maintenance of work train engines, cars, pile drivers, steam shovels, and snow plows are chargeable to different accounts.

Maintenance of the track is construed to include surfacing and lining, patrolling track, clearing weeds, clearing snow and ice, plowing fire guards, fighting fires on the right of way and adjacent property, and sprinkling roadbed with oil to lay the dust. All of these are incidental costs in maintaining the track in normal operating condition.

Comment.—This head would seem to be far too inclusive. The temptation is to make such very general accounts a general "dump." The maintenance of the roadbed is against generally different conditions from the maintenance of the ties or the rail, switches and frogs and signals. And the maintenance itself is made to include the expense of natural deterioration, of extraordinary weather, and of transportation contingencies and betterments. Were the account smaller, such itemization would not be so obvious. There can be no consistency in charging the cost of maintenance of some tools to this account and of others that are used for the same purpose, but because they are larger and are on wheels, to maintenance of equipment account. Switches, frogs, switch stands, and rail fastenings are properly as much a part of the rail service of the roadway as the thirty foot lengths of rail, and the labor of distributing, slotting, drilling, and laying rail are quite as valid a charge against rail service as the delivered cost of the rail itself. The same reasoning applies with equal force in case of ties whose expense of distribution and laying are thrown into this account, while the first cost of the tie is placed elsewhere. If general superintendence, maintenance of way and structures, which extends to include other work than roadway exclusively, is placed

in this account it should be separated from such superintendence as is special to roadway proper.

Examination.—If the charges to this account run heavy, in the absence of special information as to extraordinary weather or faulty management, they would indicate that the road had been bettered—raised to a higher standard. In support of this, the betterment items, such as ballasting, lining tunnels, widening slopes, and filling trestles should run heavy. And where betterment items are high there should be reflected some favorable results in a falling off in the general charge for surfacing, lining, and adjustment, and, perhaps, patrolling track. The rail and frog renewals may be heavy because the rolling stock is too light for the service required, or because the standard of rolling stock has been seriously let down. The introduction of steam shovels, ditchers, centrifugal snow plows, and other large tools would tend to greatly reduce the expense of certain parts of the work, because, as the accounts are kept, roadway is enabled to escape the great part of such expense from which it has the full benefit, by charging their first cost to construction and their maintenance to maintenance of equipment. So also any betterments that are charged to construction, which materially reduce the running cost of maintenance, such as snow sheds, piling, to protect slopes, extraordinary ditching, rip-rapping, etc., relieve roadway expense in the same manner. The standard of roadway service furnished must very largely enter to affect roadway maintenance expense. This standard will be indicated by the train miles per mile of roadway, the cars per train, and the average speed, because for high service the track must be kept in extraordinary condition. Side-track maintenance will be from one-half to two-thirds as expensive as that of main line; it is not so imperative that side tracks be held up to a rigid standard all the time in order

to meet operating conditions. Therefore their repairs should be shown separately. Yard maintenance should be a separate item for the same reasons.

In comparing the maintenance expense of different roads or divisions of the same road, the geological formation, climate, topography, existing standard of the road as to service or condition of maintenance, and the age of the road bed and ties enter, to render any judgment almost impossible. As the road becomes older, the natural physical conditions become less and less a factor in determining expense, while the standard of the road, as determined by the demands of service, becomes the controlling consideration. In this way it becomes true that there is an indirect relation between the cost of maintenance of track and the train mileage. But with all its wide variations the general cost per year for a single-track road may be kept in mind as ranging from $300 to $450 per mile of main track.

2. RENEWAL OF RAILS.

This account is to cover all the cost of rails used in maintenance, including their first cost, their transportation and inspection, but not their distribution or any labor in placing them. It is well to consider it as simply an item withdrawn from the general account "repairs of roadway," because it is a very considerable item, but especially because it can be measured exactly. Rails are considered rails, and charged to this account, regardless of where they are used, whether on main line, spur track, siding, gravel track, repair tracks, shops, bridges, turntables, piers, wharves, coal chutes, etc., or whether used as the main rail or guard rail. The specification is so all-embracing that there can be no confusion. It does not include any rail fixtures whatever, as angle plates, bolts, frogs, switches, crossing angles, tie plates, etc.

Comment.—By charging to this account, which is a subhead of roadway maintenance, the rails that are used for other purposes than train mileage or commercial purposes, we are distorting the first general notion of our general head. Because a piece of steel of the same templet is used in the shop as on the road, is no reason to assume that it contributes to the same result, and so belongs in the same class of expense. If for instance we suppose a road has by a new policy ordered its rolling stock repaired by a connection, then immediately the incongruity of charging the maintenance of the repair track to the same account as the road track becomes apparent. It would be as reasonable to charge also the rail for the traveling crane in the shop to this account as we do find is the case with the rail used for the transfer table at the shop. Again at terminals are the track scales, turntables, switch yards, coal chute trestles, etc., which shade off by degrees from the general track service of the road to special uses incidental to operation. They are not all equally inseparable and unchangeable features of operation, and further, the conditions of wear and maintenance are radically different. All such should first be withdrawn from the line-of-road track. Such as are special to a particular use, that is, more or less changeable according to the methods employed, should be charged to the same account as the uses they serve. Where not so independent of the general plan of operation, they should be itemized as a roadway expense under the head of the particular use served. Especially does this criticism apply in case of gravel tracks, and coal chute trestle tracks.

As noted under the head of repairs of roadway, it is not obvious why rail fastenings, frogs, guard rail braces, etc., and the cost of distributing and laying rail should be separated from the cost of the rail itself, especially when guard rails are excepted from the gen-

eral exclusion. The classification includes transportation as a part of the expense of rail renewal, but does not define what shall be considered the point of delivery from which further transportation is charged as "distributing rail," to repairs of roadway. It does not specify whether custom tariff or a company rate or no charge at all applies as a proper transportation expense. In the case of a large system and a branch line, a great part of the transportation from the point of purchase may be over the parent line.

Examination.—The line-of-road track should be watched entirely by itself. The cost to this account per mile is merely a matter of price of rail, though over considerable periods the efficiency of the rail and rate of renewal will enter to appreciably affect it. If the standard of maintenance is very irregular, the rate of renewal will be the only factor of importance. Other factors, except over very long periods, will be impossible to determine. The rate of wear must be explained by the weight and speed of trains and condition of rolling stock more especially than the ton mileage. It also will be largely affected by the standard of ties, ballasting, and surfacing, the alignment and gradients and extent of curves.

The miscellaneous trackage, not a part of the main line, can only be watched in a general way because its standard of maintenance and degree of use has no uniformity, since the requirements made upon it are of great variety. Some of it may be only for storage of cars, for which the worst refuse of the scrap pile will suffice, other tracks in this class may be for main line passing sidings, in which case the standard may be scarcely inferior to that of the main line itself.

3. RENEWAL OF TIES.

This account embraces the cost, inspection, and delivery of all ties, whether cross ties or switch ties and wherever laid, whether on main line, sidings, yards, spurs, shops, coal chutes, gravel or ballast tracks, depots, bridges, or trestles. The maintenance is against wear, deterioration, or the damage or loss by fire, freshet, or accident. In the absence of instructions to the contrary and in accordance with the practice of many roads and the general nature of this account, it would include the cost of any preservative process applied to ties and also cost of tie plates and tie plugs or other devices whose sole purpose is to lengthen the service of the tie. Some roads construe the instructions liberally, and charge the bridge ties to bridges and culverts account, but there is no good reason for this. It is true that the tie specification, and consequently its cost and wear, differ in some degree when laid on the bridge as compared with that laid on the roadbed; but there is often quite as great difference in specification of ties used in different soils on the same road. And whether on the bridge or roadway they serve the same general purpose. No labor except that of inspection is included. In case of replacement the value of any material removed applies as a credit to the work done.

Comment.—The same criticism applies to this account as to renewal of rails, in that there is no distinction among the uses which the tie is made to serve according to where it is placed, and that it is separated from the labor charge for replacing it. Also what constitutes the proper transportation charge is not defined. This becomes a most important consideration on a system composed of subsidiary lines in all stages of ownership.

Examination.—The life of a tie varies according to

the kind of wood, the climate, nature of ballast, drainage of roadbed, mode of dressing, the kind of special chemical treatment, bearing service demanded by rail, alignment of track, weight of rail, and speed and weight of rolling stock, and whether the rail joints are suspended or supported. According as these elements enter in various degrees, a tie will last from four to twelve or thirteen years, if of wood; and if of steel the life is perhaps thirty years. But for most conditions the life of a wooden tie is six to eight years. After the ties have been through one or two periods of renewal the need for renewal should be tolerably even, from year to year. But from month to month the cost of this account will greatly vary, because a roadway department, properly managed, will make its tie renewals only in the most favorable seasons of the year. There cannot well be any great variation in the standard of tie maintenance over several years on any road that does any business, because the ties cannot be long neglected without imperiling the safety of the road. To eliminate from consideration the variation in price of ties, it is general to watch the rate of renewal in number of ties replaced per mile of track. Because the standard of service required is so different in sidings, yards, and spur tracks, etc., the ties used there should be kept separate from those used in the main line.

4. REPAIRS AND RENEWALS OF BRIDGES AND CULVERTS.

This account is to cover the cost of maintenance of so much of the roadway as consists of structures which are exposed to special kinds of wear and deterioration and risk which differ from that of earth roadway, and require different material, skill, and supervision. Cattle guards and road crossings, although coming under this general description, are not included because the

need for them arises from a different class of causes. Structures not in the roadbed, as a part of the roadway, are in a separate class because they are not so permanently a fixed feature of railroad operation, but are separable from the general property and may be convertible to other uses than transportation. Also they are not due to the topography of the road but to its volume of business and facilities offered. It thus includes not only the maintenance cost of bridges, trestles, viaducts, and culverts, both of their substructure and superstructure, but also the maintenance of piers, abutments, retaining walls, drain pipes, rip-rapping, dykes, false work, cofferdams, and like structures for their protection or re-enforcement. Maintenance is not only against wear and ordinary deterioration, but against fire, freshets, ice, wrecks, or lawlessness. The maintenance of a bridge is further construed to include the watching and tending of the bridge, the operation of drawbridges where they occur, the fuel and supplies for and maintenance of stationary engines at drawbridges. This is upon the theory that the bridge is a part of the permanent way, but its operating expenses in keeping open the waterways when required, and protecting from fire and freshet, trespassers, etc., are simply features special to its own maintenance, and not a part of the operation of the road. They are a charge against maintenance of way and structures, because they have no relation to the volume of train movement. Together with direct charges under the above descriptions are included all incidental expenses, cost and maintenance of tools, expense of work trains, pile drivers, etc., while engaged on bridges or culverts, but not their first cost nor maintenance. In accordance with the usual provision the cost of removing old structures, preparatory to the construction of new, is made a part of the expense of the new. Superintend-

ence, special to bridges and culverts, is charged to this account, but not any proportional part of a more general supervision.

Comment.—Just so far as locomotives, cars, pile drivers, and other large tools are used for the benefit of this account and no rental expenses are assessed for the interest on their first cost, and maintenance and depreciation, the deductions to be made from any figures used are misleading. If the use of these tools were invariable under the same conditions and the bridge were always the exclusive property of the road, and the question of its cost never could enter as a factor in determining any bridge tolls levied, there could be no reason for adding these rental costs. In the same manner a transportation charge to cover the actual direct cost of hauling material used in bridge renewal should be assessed.

Examination.—This is a class of costs that varies greatly according to the rate of renewal. The roadbed must be maintained approximately up to a certain standard at all times, while a bridge, if of wood, may be maintained up to a certain safe standard through its life, at a nominal cost for repairs, and when its usefulness expires it must be replaced at a cost equal to the first outlay or even greater, and the cost of this renewal is charged to maintenance. This account may vary greatly from year to year, therefore. This of itself is sufficient reason for withdrawing bridges and culverts from the general class of roadbed expense. The tendency is to raise the standard of rolling stock and this has materially altered the type of bridges, and so has made expenses include a betterment, which has, by so much, increased the amount of this account. In order to avoid the irregularities thus produced in expense figures, current repairs should be kept separate from renewal. Renewal that includes betterment should be separate from mere renewal. The current

repairs and renewals should be shown separately for the different kinds of bridges, as they have a different normal rate of application.

5. REPAIRS AND RENEWALS OF FENCES, ROAD CROSSINGS, AND CATTLE GUARDS.

This account is intended to provide for all those structures along the right of way that are not an essential part of the roadway for moving trains, nor for handling traffic, nor for the facility or safety of passengers at stations, nor incidental to the maintenance of the roadway and the rolling stock, nor the general administration of the property, but which grow out of the operations of transportation as they affect or are affected by the abutting interests, property holders, and general public along the line of the right of way. Hence it comes to include the maintenance of fences and cattle guards, road crossings, overhead bridges, crossing signs and gates, whistle posts, slow and stop boards, and cost of maintaining lights at points where public highways cross the right of way, the assessments for street repairs or sewers where not incidental to any particular building or separable part of the property, but general to the right of way, street railway crossings, and mile posts. The bridge necessitated by the separated grade crossing of two railroads is classed as an overhead bridge by the lower railroad and as a regular bridge by the other railroad. Perhaps the reason lies in the fact that the overhead crossing is generally a condition subsequent to the construction of the road which is at grade, while to the other road the overhead bridge is generally a condition precedent to construction. Therefore it is a part of the original disabilities of the projected line, as much as those due to natural topography. As an expense arising subsequent to construction

and due to conditions outside of those contemplated in the original projection of the road or growing out of its operations, the maintenance of an overhead bridge, whether it be to carry a highway or another railway, bears practically the same relation to the railroad's operation. The account includes the cost of all tools used and any superintendence specific to this account, but not such as is enjoyed by it in common with other accounts.

Comment.—The rapid growth of street railway systems to interurban lines, their speed, weight of rail, and weight of rolling stock, raise the question whether their crossings be longer considered in the class of highway crossings, or be placed with crossings of full standard railways. It is true that their grade is indifferent, their roadbed lighter. Their necessity for safety crossing devices is less, since they have less speed and easier control. But their ties and their rail are generally equally heavy with those of the railroad, and the maintenance of the crossing angle is the same as that of a standard railroad, which is charged to repairs of roadway. Mile posts are less in keeping with the general tenor of this expense than with repairs of roadway, where it would seem that they belong, along with switch stands and signals and other operating devices. This also is true of slow boards and stop boards, where not in connection with crossings, which are charged to this account.

Examination.—Like bridges, this has no exact relation to miles of roadway, but, unlike bridges, it is subject to increase. This increase, however, like buildings, may not have any relation to the volume of business. While it rests on the same general conditions it does not depend on traffic, but on the density of population, nature and extent of general business along the territory through which it passes, and irregularities of local ordinances, laws, and requirements. It may

have a very direct relation to loss and damage, property and stock, and injuries to persons not passengers. Where crossing watchmen are replaced by automatic warnings, the maintenance expense will be increased, but the transportation expense for switchmen, yardmen, and watchmen will be less. Repairs, renewals, and extensions should be kept separate for fences, road crossings, cattle guards, overhead bridges, and miscellaneous items.

6. REPAIRS AND RENEWALS OF BUILDINGS AND FIXTURES.

This account is to include the cost of maintenance of those structures along the right of way or incidental to the road's transportation, and included in its property which are not an integral part of the roadway over which the trains move.

They are first the terminal facilities for handling, equipping, and dispatching the train, as the roundhouse, coal chute, water station, sand house, turntable, watchman's box, yard and telegraph office, and signal tower; they are next the buildings incidental to handling the traffic and facilities to the public for their necessary service, convenience, and even luxury. Such are passenger depot and café, and freight warehouse, coal storage grounds, elevators, stock pens, and track scales. They are next the buildings incidental to the maintenance of the rolling stock and the right of way, as shops, storehouses, section and tool houses, division offices. Finally they are facilities for securing traffic and for the general administration of the property, which are the soliciting agencies and the general offices.

But any buildings which produce a direct revenue of their own, which is not included in freight or passenger revenue, are excluded, because their particular

earnings should be made to bear their particular expense. Such structures would be elevators, stock pens when conducted on a self-supporting basis, and buildings occupied by tenants.

With the buildings are included all the incidental parts and accessories, as cost of excavation, foundations, drainage; water, gas, and sewer pipes; heating and lighting plant, cisterns, wells, terracing, fencing, paving, special improvement taxes when directly connected with buildings, and the usual charge of the expense of removing old buildings for the construction of new. But sprinkling streets, mowing lawns, cleaning premises, caring for flowers are a conducting transportation expense and not a proper maintenance charge.

With the buildings and their accessories are included the fixtures that are more or less an integral part of the building. Their first cost (except in connection with the construction of the building), their renewal and repairs, are charged to this account. Fixtures would be such things as cranes, derricks, office railing, furnaces, storm doors, counters, etc. Furniture would be tables, stoves, clocks, chairs, desks, carpets, etc.

Comment.—All buildings are thrown together indiscriminately, without reference to the permanence or general nature of their use. Thus the shop, the depot, the terminal facilities, the watchman's box, and the general office are in the same group. In this way the extent to which any department is enjoying building facilities and incurring maintenance expense is covered up. In case a building is assigned to some temporary, special, and irregular service, either the actual maintenance or an arbitrary rental charge to cover maintenance and other costs, should be placed against that service. The principle is distinctly recognized in case of elevators, whose earnings are not in-

cluded in freight revenue. It is equally applicable to lunch counters, parcel rooms, cab offices, etc., to the extent that they have any direct costs of maintenance, and where such service is more or less optional.

Let a department once get a shop or an office convenience, and although it may prove unnecessary, its maintenance is after that a fixed charge on operations. The question of its continuance or abolition never comes up, because its expense is never charged to the thing or class of things which it serves.

Furniture should not be included with fixtures. The line between fixtures and mere furniture is necessarily arbitrary. But the general principle of the distinction is that an article specially designed for that particular building or a limited number of its class, that could have little or no use elsewhere or that is fitted to the building so that it could not be easily removed and adapted to other uses, is a fixture. All other articles which are not supplies are furniture. The line is drawn at that point because the fixtures or attachments are more or less inseparable from the building. Also their life corresponds in a measure with the life of the building and their usefulness must be consumed with it.

They are in the doubtful region between those things that are of definitely direct consumption, such as supplies or small articles of furniture, and those things that serve a long use as a fixed property.

For such, both the renewals and repairs will be charged to the same account as the renewals and repairs of the building. The exceptions will be some rare cases where the element of wear by use comes in, to affect their repair charge independently of the repair charge of the building. In these cases the repairs should be charged to the current expense of the account served, but the renewal should still be carried to maintenance.

Furniture is those articles that have a usefulness that may be entirely separate from the building or buildings of its class. As generally indicating this separate usefulness, they are thought of as movables. In addition to their separability in use from the use of the building they generally have a separate wear. Therefore, their repairs and renewal do not necessarily bear any relation to the repairs and renewals of the building. For these reasons the repairs and renewal of furniture should not be charged to this account.

Along the line of the distinctions as laid down above there are some fixtures whose repairs are properly chargeable to use as a current expense, while their first cost and renewal would be in the nature of maintenance of the building.

It would be proper to charge their current repairs to direct expense but their renewal to the maintenance. This principle is in part indicated in the two latter paragraphs of the classification.

Examination.—This is a cost that can fluctuate very widely because it is not absolutely necessary to safety of operation that all buildings be maintained at an exact standard. They may be allowed to fall far below their original type or they may be carried above it without appreciable effect on the operation of the road. Especially is this true of those buildings that are for the comfort and facility of the traveling public, which constitute so large part of the buildings of a road. Sometimes this account may be heavy, by a decline in the rent account, when the road undertakes to substitute buildings of its own for rented property. But, in general, any large expenditures here are an indication of substantial investment for the benefit of the public and betterment of the property. If electric light plants have been installed to light the station, offsetting the new maintenance thus incurred, there should be a reduction in station expense. Again,

plants may be installed for charging cars with illuminating gas, or new water stations or special water services may be set up, and these should effect a corresponding reduction in the accounts usually charged with the current expense of such service.

In the most superficial examination the expense should be divided into new buildings, renewals, and repairs. The new buildings, if possible, should be divided into offices, stations and terminal facilities, and shop and roadway buildings.

7. REPAIRS AND RENEWALS OF DOCKS AND WHARVES.

This account is to provide for all those costs of maintenance of water facilities, not afloat, which are an irregular feature of railroad transportation, and because of their special nature are held to themselves. A railroad is conceived to be a plant for transportation by land exclusively. Its service is computed in haul of road miles. When it develops water terminals, or by ferriages or otherwise introduces water transportation, an entirely new set of conditions are set up. These differ from those of the rest of the property in the permanence of the policy on which their continuance rests, in the nature of their wear and deterioration, in periodicity of renewal, in the kind of labor and material, and the special facilities, superintendence, subordinate plants and outfits, incidental to this maintenance. Every cost, then, whose effect is in any way special to the fixed property, water facilities of the road, is a proper charge to this account. An added reason for a separate account for this class of expense lies in the fact that water facilities generally, because they belong to a different kind of business, are easily detachable from the general railroad property. They very often have a direct value in themselves, in-

dependent of their relation to the railroad. The first purpose of this account is to provide for the maintenance of wharves used in the regular line of transportation. The docks to the pond of some picnic grounds would not belong to the class here provided for. They are a mere incident to the operation of some pleasure park that is an insignificant and more or less temporary feature of operation. They do not belong to a scheme of water transportation that is part of the general rail line of the system.

This account includes not only the maintenance of the docks, wharves, bulkheads, piers, and inclines thereto, but also the jetties, the cost of dredging the channel, and all incidental expense of operating pile drivers, tugs, barges, floats, dredges, mudscows, etc., while engaged in dredging or otherwise repairing the property.

The structures that come within the class contemplated by this account, being limited to those that are special to the water service, would not, therefore, include such buildings or such parts of the buildings as are used for warehouse purposes or do the service of a regular depot. Elevators or warehouses may be built upon a pier. They would not differ essentially either in their uses or in their construction from similar buildings not located on the pier. The maintenance of such buildings should be charged to repairs and renewals of buildings and fixtures, while the maintenance of the piling, wharves, and bulkheads beneath or adjacent to these buildings would be chargeable to repairs and renewals of docks and wharves.

Heavy platforms for coal and ore along the line of the road are sometimes called "docks," and the expense of their maintenance is charged to this account. This is plainly incorrect. Such expense should be

charged to repairs and renewals of buildings and fixtures.

Examination.—Owing to the irregular and indefinite extent of the property of this kind, there is no reliable measure of it save, perhaps, feet of water front. Some roads which handle a traffic subject to great fluctuations in volume, here seek to steady this volume by providing extensive warehouse facilities and storage grounds. In case of a water and rail line these warehouses will be on the water front at the point where the freight is handled to and from the ship's side. Thus it will have very extensive wharfage simply to accommodate these great warehouses.

In stating this expense, renewals should be kept separate from mere current repairs or expense of accident. Where roads subdivide the account into dredging, docks, piers, and re-planking, if they should show the yards of dredging and the feet board measure of lumber used under the last three heads against the whole number of feet in the structure, we would have at hand a basis for judging of the expensiveness and rate of renewal.

8. REPAIRS AND RENEWALS OF TELEGRAPH.

The telegraph plant justifies a separate head of expense, because it is a very large and ever-present element of all railroad operation. The skill, outfits, tools, etc., necessary to its maintenance are largely a special kind, and it generally follows that it is under a separate general supervision. With the telegraph is included the telephone, because their maintenance and repairs are of the same general nature and their uses largely interchangeable. The telegraph and telephone plant is considered to be only the actual lines, batteries, instruments, and tables used for telegraphing. All expenses for tools and miscel-

laneous supplies incidental to maintenance of telegraph and telephone lines, and not operation, are included in this account. Buildings used, either entire or in part, are not included. Repairs of all telegraph and telephone lines, whether owned or leased, for whose maintenance the road is responsible, are charged to this account. The road may only participate in a joint expense, or may maintain its wires strung on the poles of another company, or it may own both wires and poles and lease the right of way. In all forms of contracts with the owners or joint owners of the telegraph line, the maintenance, whatever it be, for which the road is responsible, goes to this account. The rent expense, because it is a specific charge to one earning period, goes to "telegraph expenses, conducting transportation."

Comment.—By the classification, buildings used entire, or considerable parts of buildings permanently converted to the exclusive use of the telegraph offices, are not included. If the road owned its telegraph plant entire, or if the extent of its plant were a fixed thing, or if its growth were regulated entirely by the volume of the road's regular business, there would be little reason for withdrawing the buildings used for telegraph purposes from the general class, "buildings and fixtures." But, inasmuch as it involves a joint operation of two distinct interests, and the status of the two interests is liable to changes through fluctuations in the volume of commercial telegraphy or the railroad's needs, it is questionable if it is well to leave out of the telegraph maintenance accounts those maintenance expenses which may fluctuate with the extent of the telegraph service. Outside the general service to which all departments have access or that belongs to the general movement of trains, there are often short private lines for convenience of shops, roadway, or traffic officials. When this service is performed by

a local telephone company the expense is charged to the office incurring it. It would seem proper to charge maintenance of such lines as are operated for this purpose to the same account.

Examination.—The repairs may be very erratic, because of storms. Unlike most items, this account bears little relation to other accounts, to affect their expense, for the telegraph must be kept up to a normal operating condition. The only exception to this is in case a renewal is made in copper wire, which is very expensive. Such outlay is justified because it offers a service that is less liable to the interruptions of defective working.

Renewals which come once in ten or fifteen years will best be kept apart from repairs. Mere repairs per line of wire will run from $3.50 to $5 a year, but with renewals included, the expense runs all the way from $9 to $13. The variety of contracts with the telegraph company in respect to dividing the cost of maintenance renders it difficult to make comparisons of expenses between different roads, or between different divisions of the same road.

9. STATIONERY AND PRINTING.

This includes all of the supplies incidental to office work, such as stationery, printing of blanks and circulars, ink, pens, pencils, desk conveniences, typewriters, letterpresses, cyclostyles, mimeographs, and like duplicating processes. It includes such stationery as is used by the maintenance of way department, but not such as is used by the auditor's office in handling maintenance of way figures. This is a supplies account, embracing for the most part only those articles that are of current consumption in connection with clerical work. Typewriters, letterpresses, cyclostyles, etc., are not strictly supplies, but are of the

nature of tools or small furniture, and it accords with the general principle of charging out the renewal or repairs or even the purchase of such small or miscellaneous articles, to include them in this account. Desks, file racks, or such office fittings are generally classed as furniture. In the division maintenance of way offices, this would be charged to superintendence, and in the general maintenance of way, or engineers' office, to general office expenses and supplies.

Comment.—It is doubtful if this is a sufficiently regular and significant item to justify a separate head. There is little stationery and printing expense of the maintenance of way department along the line of road. That at the chief engineer's office is elsewhere provided for.

Examination.—For the most part this is an administrative detail, covering a form of cost that is not fixed at all with reference to the entire body of work done, because the method requiring more or less outlay under this head may change from time to time, and it will also be irregular from the irregularity in the introduction of new forms on a road where there is much change in blanks. At one time a given part of the work may be done at the division office, and again in the auditor's office. Again, a blank may be substituted or a printed circular, a typewriter, or a duplicating machine that will materially affect cost. In short, this is a general account that may be legitimately swelled irregularly to produce special results, or results produced in a particular way, which will not appear in the general result.

10. OTHER EXPENSES.

This includes all expenditures not otherwise located. It is a general account, and may not have any definite relation to the other accounts. It will embrace

charges that are irregular and extraordinary in their nature and that do not contribute directly to any of the regular parts of maintenance of way, as roadway, ties, bridges, buildings, etc. Such would be general gratuities to employees of the department, detective expenses, account of the maintenance of way department, newspapers for employees' reading rooms, premiums paid in any employers' liability insurance association, injuries to employees that cannot be specifically charged to any one part of the work, or cost of working tools or royalties that serve a general use for all the department. Sometimes the depreciation of roadway material, held in stock until it becomes obsolete, is charged to this account, instead of the detailed heads of account to which the charge would have gone if the material had been used. This would be upon the theory that the cost was a direct loss due to the fault of the management, and hence a general charge like superintendence. But the general theory of a charge is that each account must register all the mistakes of the management. We see no reason for departing from the principle in this case.

It is a very proper head of account, and it is difficult to specify in advance all the items that properly belong under it because of the very fact that they are irregular.

Examination.—This should not at any time be a large account. But where it is, the items are in the nature of special disbursements that must each be examined by itself. If the railroad in its relations with its employees, or, as a property holder, with the public, meets with unexpected or irregular necessities for outlay that are not properly chargeable to any one of the regular heads of cost, this account will be swelled.

MAINTENANCE OF EQUIPMENT.

II. SUPERINTENDENCE.

This account includes those fixed costs of superintendence special to the maintenance of equipment, and not special as an irregular charge to any one of its regular heads. Such charges for superintendence as are affected by the volume of work done will be charged directly to the account where they apply. So soon as any form of work becomes a regular part of the maintenance of equipment, the charge for superintendence in connection with it goes into this general head. Thus the account will include superintendents of motive power, and car departments, master mechanics, master car builders, general foremen and their clerks and attendants; also their incidental office expenses for heat and light, etc. The auditor of motive power is added, on the theory that his entire time is taken up with the affairs of this department. Road foremen of engines are not charged to this account, but to engineers and firemen, conducting transportation.

Comment.—If the auditor of motive power is simply the chief of a clerical department of the maintenance of equipment department, and his auditing is not a part of the final auditing of an account, but carries no further authority than that of the maintenance of equipment department, then this is an entirely proper charge. But if he is a part of the auditing department and, as far as he goes, audits an account, the expense of his office is not a proper charge against the mainte-

nance of equipment. It is immaterial where, for convenience or expediency, he may be located. The services of the road foremen of engines avail the transportation department, in regulating the fuel consumption and bettering the engine running. They also avail the maintenance of equipment department by keeping it advised of the running conditions of the motive power and by training the men to better care of their engines. Thus there would seem to be equal propriety in charging the salaries and expenses of road foremen of engines, either to maintenance of equipment or conducting transportation. But with the added consideration that the personnel of this staff comes from the maintenance of equipment department, that it is a staff place regulated more by the number of engines to be maintained than the actual engine miles run each month, it would seem to be more properly a maintenance of equipment charge.

Examination.—This account is largely in the nature of a fixed charge. It should have no violent fluctuations, but should remain at approximately a constant figure like rent. It must be studied by itself as an inquiry into the nature of the organization and the rate of pay for individuals. While it may not bear any constant relation to the general body of maintenance of equipment expense from month to month, yet through longer periods it should be nearly constant. Not only does the volume of the work affect the volume of superintendence necessary; it also affects the quality of that supervision in the responsibility assumed. This must be compensated in the salary and dignity of the official in charge.

12. REPAIRS AND RENEWALS OF LOCOMOTIVES.

This account includes all the direct costs for maintenance of locomotives and all fixed parts or attach-

ments, whether for increased safety, speed, convenience, or appearance, together with any regular equipment of tools. Thus it will include the repairs and renewals of tenders and snow plows when permanently attached to locomotives. All tools and supplies used in the repairs, in the same manner as the labor and material, are charged to this account.

Maintenance is understood to include only such work as has an effect lasting over an indefinite period. Such expenses as cleaning out boilers, painting smoke stacks, packing cylinders, wiping and oiling are effective only over a single run or a very few runs. They are direct current expense and not maintenance.

Maintenance is also understood to include not only the current repairs and the periodic overhauling, but the replacement of old, worn-out, or destroyed locomotives with new, the purpose being to keep the equipment rigidly up to its original standard and first quota. Royalties paid for the use of attachments are a part of the cost of those attachments and should be charged with them.

Comment.—The repairs of loose and movable tools that go with the locomotive are more properly a direct transportation expense under the head of other supplies locomotives, than a maintenance expense. In the list of articles and parts given are included brooms, flagstaffs, glass guages, oak packing, torches, etc., which verge close on to the nature of supplies that are properly an expense charge.

Examination.—This is an account that cannot be reduced for any long time continuously by lowering the standard of maintenance, because the safety margin is too narrow. But it may be very much increased by raising the standard of service in weight and speed. An element that will enter to greatly modify it is the age of the locomotives. Toward the latter part of the life of a locomotive the annual repair charge

will mount up to from one-fourth to one-third of the first cost. On many roads thirty-five per cent. of the first cost is the maximum figure that repairs are permitted to attain. At that point the locomotive goes into the scrap pile. The kind of service so largely determines the repair cost, that engines of each service, where definitely assigned, should be kept separate, and the mileage placed against each. With the use of larger engines the repairs charge per engine mile should normally increase, though at less than half the proportion of increase of weight. The condition of the track will affect engine repairs, though it is impossible to measure the amount of such effect. The length of run, the extent to which the engine is allowed to cool between runs, the extent of roundhouse inspection and repairs enter as large elements in affecting the amount of repairs. With the perfection of the repair plant there will each year be a larger and larger amount of fixed expense for interest on first cost, and depreciation and maintenance of improved tools and shop facilities that are never charged to engine repairs, but are offset by economies in shop work.

A normal engine repair figure is about six to seven cents per mile, but it will easily range from five to nine cents, according to the service first, and then, according as severally enter all the elements just cited.

13. REPAIRS AND RENEWALS OF PASSENGER CARS.

This embraces the maintenance of all cars used directly for the transportation of passengers or that may be run in connection with passenger traffic as baggage, mail, express, pay and private cars, or freight cars fitted out to haul passengers. So also will be included milk cars and bicycle cars, on the theory that they are but a specialization of the miscellaneous service performed

by cars generally run in connection with passenger movement.

With the cars are included all their furnishings, fixtures, and movable parts, as bell cord, stoves, coal hods, fire extinguishers, links, pins, brasses, lamps, water glasses, etc. But oil and waste and tools used in oiling cars, and material and tools used in cleaning cars are considered supplies, and are an expense and not a maintenance charge.

With all charges applied are included the cost of the small tools and material used, the direct superintendence, and inspection, embracing the car inspection on the line of road. This rests on the theory that the expense of whatever nature to preserve a car in operating condition is a maintenance charge. But the indirect expense for first cost and interest on first cost, depreciation and repairs of large tools or plants used in connection with the coach maintenance, are not charged to this account.

Maintenance is construed to be such applications of labor and material or other cost as have an effect lasting beyond a single run or very limited number of runs. Thus it is distinguished from expense, and also separated from construction or capital charge, by the distinction that it is the preservation and not the increase of an existing number of cars at approximately the first physical standard. Thus their renewal or replacement when worn out, damaged, or destroyed, less value of scrap, the amount of insurance or any damages collected from other parties, is a charge to this account. Expense arising out of damage to cars hired is also included, because it is that part of the cost for a service had which would have been charged to this account if the equipment had been owned. It must often happen that the type of car will become heavier, more elaborate, and more expensive, thus increasing the maintenance expense per car and also increasing

this account by the excess cost of the new type over the old type replaced. Such betterments generally go entire to the benefit of the traveling public and cannot be connected with any increased earning power or economy elsewhere, and so are not generally capitalized.

Comment.—The cars should be separated into classes according to the kind of revenue against which they are a direct expense, such as baggage and passenger, mail, express, milk, sleeping, officers', dining cars, etc. Further, only such cars should be included in the regular maintenance of equipment account as are in revenue service. Cars in special revenue service, as a dining car or a sleeping car, under some conditions, may be withdrawn to separate operating accounts. Cars used for shop laborers or officers, or paymaster or air-brake instruction, should never appear in the class of revenue earning cars. This principle is acknowledged in the case of train expense of laborers' cars, but there is no reason why it does not apply with equal force to maintenance also, and to officers' and other such cars. The maintenance of these cars should apply as an expense to the department served, else a fixed charge is saddled on our general maintenance of equipment account for the special benefit of individuals or departments, and is lost to sight.

The line between supplies and material chargeable to maintenance defines the expense of bell cord, carpets, coal hods, keys, stove furniture, matting, and wash basins, also links, pins, brasses, etc., as maintenance. It is confessedly difficult to draw any line. But the principle of any distinction made would seem to be that articles of direct consumption or whose expense is distinctly independent from the general expense of the car, through breakage, loss, or special wear, and which are separable parts of the car equipment, while

not supplies proper, are of a separate class. Their current renewal should be charged to expense and not maintenance. When the renewals are made at the shops, at the time of overhauling a car, as a part of the expense of restoring it to standard, they would then be a proper maintenance charge. The distinction may seem finedrawn, but it becomes obvious when we undertake to watch the transportation item, train expense.

Examination.—The repairs charge must be placed against mileage, and by classes of cars. Renewals must be examined separately, and should bear a relation to time as well as mileage. Repairs incurred by accident should be a further item. The age of the cars, the extent of betterment going on, the condition of track of which there may be a partial indication in the amount of money spent on it, the curvature and grades, mileage per car per day, number of stops, the standard maintained by current repairs, weather, speed, length of trains, and yard usage are factors that enter to determine the amount of the expense. It may be thought of as between one and two cents per passenger car mile.

14. REPAIRS AND RENEWALS OF FREIGHT CARS.

This includes the maintenance of all cars of any description that carry custom freight, and cabooses used regularly in connection with their movement. With the car are included its movable parts of brasses, grain doors, double decking, links and pins, etc., cushions, lamps, chairs, tables, and like furniture and fixtures of cabooses. The maintenance includes the expense of preserving the freight equipment at its original quota and approximately at a first standard, by repairs, renewals, and replacement. But it will not include the cost and labor in using such supplies, as

oil and waste, that are of purely current consumption. Payments for damage to equipment hired are a charge to this account. The items that constitute a charge are the labor and material and cost of small tools and superintendence directly used.

Comment.—The same general criticism applies to this account as to the foregoing for passenger cars. A grain door is generally a detachable, interchangeable part, whose life has little reference to the life of the car. It would seem to be more properly a train expense. Further it will be noticed that the classification includes in this charge a proportion of the cost of tools used in lubricating, although the labor and supplies used in connection with them have gone to train expense. Engine expense in switching bad order cars about repair tracks should go to this account.

Examination.—This account will be examined on the same general lines as the foregoing for passenger cars. The mileage to be used will be all mileage, whether loaded or empty. But since freight cars are freely interchanged among roads and since much of the foreign equipment used belongs to private companies, this account may be greatly influenced by the M. C. B. interchange rules that may be in effect. Under a "rule 8," as it once existed, a very prominent road was currently reported to have set up and run quite an extensive car repair business for profit. Needless to say, this was at the expense of the freight car repair accounts of the roads served.

15. REPAIRS AND RENEWALS OF WORK CARS.

This includes the cost of maintenance of all rolling stock except locomotives permanently assigned to service of the maintenance of way and structures department, and of all such rolling stock as may be only temporarily assigned to this service from commercial uses, the cost of its maintenance during such

time, together with the expense of adapting it for this service and restoring it when returned to its regular service. The rolling stock is construed to be not only work cars and wrecking and boarding cars, but all tools and facilities mounted on wheels that run on the track. Thus it will include dump, ditching, pile driving, hand, gravel, push cars, etc.; also steam shovels, rock crushers, snow plows, track testing and inspection cars, etc. With the cars or mounted tools are not included any of their equipment that is not a distinctly essential and inseparable part of the car or tool.

Comment.—There is eminent propriety in holding these items in a separate account. But the same reason that makes this desirable should apply with equal force to withdraw them from the maintenance of equipment account entirely and place them in the maintenance of way and structures account which they serve. This is because they are an incident and not the main business of transportation. There can be no good reason for including all movable property that chances to be on wheels in one great class distinguished from all other property and similar to one another in uses, wear, and conditions of maintenance by the single general coincidence that they are on wheels. It would be quite as proper to charge repairs of wheel barrows to the same account, because they were on wheels and, further, because they were perhaps repaired at the same shop.

Examination.—The cars and tools that go into this class are so miscellaneous that their conditions and rate of wear will be very diverse. Car mileage is not a unit of wear even for the gravel cars and never for the pile driver and steam shovel. The best unit is perhaps the days' service. The account should grow with the more extended use of large tools, and the increased expense here should be reflected in a more than offsetting economy in the direct costs of roadway work.

16. REPAIRS AND RENEWALS OF MARINE EQUIPMENT.

This includes the maintenance of all floating equipment together with its furniture and fixtures. It is a lump account to care for the maintenance expense of a service which is extraneous to the general type of railroad operations. The expenses of furniture or fittings used in connection with the renewal or repair of a boat in restoring its equipment to standard are charges to the maintenance of the boat. Inferentially the current repairs and small renewals of these same articles, while the boat was in general service, would be charged to current expense of operating marine equipment.

Comment.—Since it is an extraordinary and separable part of railroad operations it should, so far as possible, be made to bear all expenses directly and indirectly involved in its maintenance. Thus dredges, mud scows, and like large tools should be charged to this account, not only for their maintenance, but also the interest and depreciation on first cost, when their first cost may have been charged to capital account. They differ from the marine equipment used in actual operation. Their life and use are more indefinite and irregular and transitory. They are not as rigidly maintained up to a first standard, so as to be equally convertible directly to money, as the marine equipment in actual operation.

Examination.—The floating equipment must be divided by kind and nature of service, accident repairs, repairs and renewals, shown separately and placed against the days in service. The machinery maintenance should be kept apart from the boat maintenance proper.

17. REPAIRS AND RENEWALS OF SHOP MACHINERY AND TOOLS.

This account is intended to include the maintenance of all those plants and large tools and machinery incidental to car and locomotive shop work. It does not include the maintenance of the buildings in which they are sheltered nor the grounds where they are. That is, these are the costs that are locked up in fixed plants that have a usefulness not special to any one piece of work, but extending indefinitely. Therefore they cannot be charged directly to the specific work done. In almost no case would their convertible value in cash at all approximate their cost, but they constitute universal and fixed parts of the operation of a transportation property. Their use is not special to any one form or part of the work so that it has come to be recognized as a subordinate type of operation, only a little less directly essential to transportation than the rail or cars. It remains at a tolerably constant quantity from year to year, and therefore requires a tolerably constant amount of renewals and repairs. It does not include the engine and boiler plant of a drawbridge, since this expense is an incident to the maintenance of that bridge. It does not include pumping stations, since their renewal is an incident to the maintenance of buildings of which water stations are one item, and their current repairs a direct expense of water supply to locomotives. It does not include elevators or warehouses, since these are a special form of railway operation more or less outside of the general type of railway service.

With the costs for maintenance is included the expense of all supplies, as oil, tallow, and waste for cleaning and lubricating. But the expense of fuel and of all small hand tools soon worn out, and the current general labor employed about the plant, is apportioned

directly to the work on the basis of the relative amount done.

Comment.—The tools and machinery constitute a definite plant that should have a certain regularity of expense for repairs and renewals that is large enough to bear watching. There are other current expenses equally undistributable. Therefore, it would seem obvious that the expense for supplies, like oil and waste, should be also separated from the maintenance cost of the machinery as coal is. The basis defined for the apportionment of undistributed expense, as "relative amount of work done," although apparently explicit, is in practice interpreted very ambiguously.

Examination.—This is made up of such irregular items that there are hardly any general specifications for watching it. From the nature of this account it will very directly affect all those accounts which are largely made up of shop labor, because the tendency to larger and more efficient machine processes in displacing labor will be to reduce the amount of the direct charge to accounts benefited. The age and type of the machinery must largely enter to explain this account.

18. STATIONERY AND PRINTING.

This includes the stationery and supplies of the maintenance of equipment department, but it does not include the stationery used by the auditor in handling figures from this department. Fuller explanation is made under head of the same item in maintenance of way and structures department, which is practically of the same nature. The item is perhaps more important in this department, but yet hardly would seem to justify a separate itemization.

19. OTHER EXPENSES.

This includes all those costs outside of superintendence and tools and machinery that are not distributable, as the general current expenses of shops for heat, light, ice, policing, switch engine to move material, etc. It will also include all unlocated expenses of the department. The maintenance and operating of the plants for the electric lighting of other departments are charged to this account.

Gratuities to shop employees, expense of libraries, reading rooms, Young Men's Christian Associations, or educational courses about the shops are analogous items, which are generally understood to belong to this account. Depreciation of obsolete material, when it cannot be located to specific heads, also expense of strikes, are charged to this account.

Comment.—The reason is not plain for charging to this department the current expense of other departments for making their light.

Examination.—This is an administrative expense. The chief regular item is for heat and light, and this should have some relation to the seasons. Although it is the method of disposing of irregular costs which cannot be placed elsewhere, it is a very independent account, and does not affect other accounts.

CONDUCTING TRANSPORTATION.

20. SUPERINTENDENCE.

This is the expense for operating officers and their fixed establishments of clerks and attendants.

"Superintendence" is in the nature of an expense because it is of current consumption, recurring monthly. It differs from the usual nature of an expense in that it is very inflexible, being more or less of a fixed charge that has not immediate reference to the current volume of business. It is a general expense, because its effect cannot be specifically measured and its cost apportioned to the accounts benefited. It is usually thought of as the oversight and direction of the work of subordinates, but the gradations in railway service are so many that so limited a definition quickly leads to confusion.

In classifying superintendence it must be grouped under those parts of the operation to which it is special, within which it is general, and for which it is a fixed charge. Thus the expense of the general manager could not be charged to superintendence maintenance of way and structures. His service is not special to that department, nor could the wages of the foreman of a floating bridge gang be charged to the same account, because his service is not general throughout the entire department to which he belongs.

"Conducting transportation" is the direct cost of moving and getting the business. It will therefore include both transportation and traffic superintendence. It embraces first the costs, under each head, that are general for the entire road, such as general superin-

tendent, assistant general superintendent, superintendent of transportation, superintendent of car service, traffic manager, assistant traffic manager, general freight agent, assistant general freight agent, general passenger agent, assistant general passenger agent, general ticket agent, assistant general ticket agent, general baggage agent, and express superintendent, with their establishments. Next, because the road is a unit and its operating divisions are not increased or decreased from time to time, according to the immediate volume of business, the division superintendent and his train master and their staffs are included in this account. But the subordinate officers of the traffic department are not included in this account because their organization is highly flexible and traffic divisions, not being defined by physical conditions, may be readily conformed to trade necessities, which are subject to constant change.

On one side the account verges close upon the classification, station agents and clerks, by such stages as superintendent of transfer stations, superintendent of terminals, general agent. The line of division must be determined from the local conditions and in accordance with the general principles given above.

With the officer is included his establishment, because it is an organized staff, paid by salaries, which are determined not on the piece work or day wage principle so much as the general value of the service rendered over a considerable period of time, tending to render the nature of the expense a fixed charge.

Current office expenses of heating, lighting, ice, water, rent, porter, express charges are included, as also all the current expenses of private cars (but not the cost of moving them) used by the officers designated.

The superintendent of telegraph is not included, be-

cause his expense is provided for elsewhere, nor are officers of marine equipment, nor surgeons, nor road foremen of engines, nor superintendent of dining-car service or fast freight lines. The theory is that their services are special to parts only of the general operations. Freight claim agents and live stock agents, their offices and expenses, are chargeable to loss and damage property account. The car accountant is included, however, in this account. No part of the expense of superintendence maintenance of equipment is charged to this account.

Comment.—The same reasoning that would place the freight and ticket auditors in the general expenses would apply with equal force in case of the car accountant. Only such part of his duties as the distribution of cars, is strictly connected with the transportation department. As recorder and accountant of car movements, he is of the same class as the departments of the auditor's office. With the current expense of private cars should be included the cost of train crew and fuel and supplies consumed in moving them, also a car hire charge to cover the interest on and depreciation from first cost and the expense of maintenance. This is because it is an expense that is incurred entirely for this purpose and has no direct relation to revenue. Rent is mentioned as an item of this account, whereas it is specifically provided for in the account "rent of buildings and other property." There would seem to be good reason for separating "superintendence, traffic," to a separate head from "superintendence, transportation," because they are different kinds of work and represent separate responsibilities.

Unfortunately loss and damage of property are an inseparable incident to transportation. They necessitate a staff as regular and essential to the road as the freight auditor. It should be recognized as a fixed

feature of operation and be included in the general charge for traffic, superintendence, instead of the account "loss and damage property," * which should only include the actual amount of damages paid and irregular expenses incurred.

Examination.—This must be regarded as largely a fixed charge so far as increases are concerned, so that when they occur they must be closely scrutinized. The transportation superintendence will be primarily in proportion to road mileage modified by considerations of traffic density as shown in train mileage. The traffic expense should bear some approximate relation to tonnage, especially competitive tonnage. But like all staff expenses it must be examined directly as well as by comparison with the work which it is supposed to do.

21. ENGINE AND ROUNDHOUSE MEN.

This account includes the wages cost of handling engines at terminals and over the road when engaged in commercial business, except that it does not include the cost of coaling engines. The expense in case of maintenance of way or shop locomotives is charged to the account benefited. It will include the cost of engineers, firemen, hostlers, dispatchers, wipers, oilers, cleaners, ashpit men, call boys, general roundhouse labor, and superintendence. But the time of any men engaged in repairs is charged to "locomotive repairs, maintenance of equipment." The handling of dead engines preparatory to repairs is chargeable to this account.

Comment.—The salaries and expenses of traveling engineers or road foremen of engines are charged to this account. They are of about equal service to both

* The language used in the classification is not always interpreted to include freight claim departments. Many roads charge their expense to "superintendence conducting transportation."

the maintenance of equipment and conducting transportation departments. If it is thought best to place them in conducting transportation they should be charged to superintendence and not to engineers and firemen, because they are a staff service.

Examination.—This account has in nearly all of its items a direct relation to mileage. It is distinctly an expense and in no degree a maintenance item. It is independent of, and not affected by, the type of other parts of operation, except the extent and convenience of the terminal facilities. The engineers and firemen being generally organized labor, whose wage schedule is largely determined by contract, it is liable to large single fluctuations by changes in these contracts.

22. FUEL FOR LOCOMOTIVES.

This account includes the cost of fuel consumed by passenger, freight, and switching locomotives and the cost of handling fuel until placed on the tender of the locomotive. It should include not only the first cost, but also the expense of a fuel agent and staff and all transportation charges that may be assessed. Loss of coal in transportation, by wreck, should be borne by the general loss and damage account, if full commercial rate has been assessed. If hauled at company rate or no charge at all, the fuel account should bear the loss. The cost of handling will include all current costs for labor and supplies and the operation of any plant for handling, but not its maintenance.

This is so large and congruous and constant an item of expense that it is very properly kept in a separate account. The handling of it is so closely allied with its distribution that it is logical to include it with the other costs.

It should be shown by kind of service.

Examination.—This will vary directly as car miles

for each service, except switching, where it should have an approximate relation to engine days. In different parts of the country the cost of coal varies greatly, reaching from eighty cents to six dollars a ton. The facilities for handling, the grades, skill in firing and running, speed and number of stops, all enter to directly affect the cost.

23. WATER SUPPLY FOR LOCOMOTIVES.

This is a considerable and congruous current expense of operation, but, unlike fuel, it is only indirectly related to the immediate volume of business. It includes the cost of water supplied to locomotives together with the current costs for labor, and supplies, all tools, and small current repairs of the machinery plant at water stations. But it does not include repairs to buildings or renewals of the machinery which are a charge to maintenance. It will also include the cost or rent of water rights.

Examination.—This item is for the most part a fixed charge, and except where the water is purchased outright in gallons from cities or other parties, the quantity used has no direct effect in regulating the expense. Hence there is no good reason for making any charge to other departments that irregularly or in a small way avail themselves of it, as work trains or shop trains. The repairs of fixed property in connection with the water supply is a further fixed charge and is very properly carried to a subhead of maintenance. A litofuge should be charged to this account.

24. OIL, TALLOW AND WASTE—LOCOMOTIVES.

This expense of lubricants is a large one, can be easily measured, and is largely within regulation. The conditions affecting its use are generally uniform.

Thus it is a very obvious heading of expense. With it goes naturally the waste used with it.

Comment.—Oil used in lighting and cleaning does not serve the same use, does not cost the same, is not within the regulation of the same men, and therefore should not be in the same class. It would be a more proper charge to other supplies. This expense should be kept separate for passenger, freight, and switch engines. It should bear a direct relation to miles. It is affected by the seasons, grades, and speed.

25. OTHER SUPPLIES—LOCOMOTIVES.

All supplies for locomotive running and handling in regular service, not already designated, are embraced in this account, and all tools used to equip locomotives for service. These supplies, for the most part, will be those used in the roundhouse work, such as sand, waste, lamp black, etc. Torpedoes, switch keys, and links and pins are better as a train expense charge. Supplies furnished to work or shop trains are not charged to this account. The cost of fuel and labor at sand house enters into the cost of the sand, which is included here.

26. TRAIN SERVICE.

This account is to cover the wages cost of moving revenue trains between terminals outside of the costs for motive power, which are provided for in the account engine and houndhouse men. Thus it will include all the railroad's employees on the train, except those on the engine. They will be conductor, ticket collector, brakemen, and flagmen, together with any form of special service put on for the better convenience of the passenger service, as water carriers, car porters, etc. But conductors of specially conducted

tours, guides, and like extraordinary expense of special service should be charged to outside agencies. Pilots necessary in case of washouts, in going over another road, will be charged to train supplies and expense.

Comment.—The reason that eliminates the porters of private cars from this account would eliminate also the other train service expenses of a full train run special for officers' purposes. The type of train service on passenger and freight trains is sufficiently different to justify two heads of accounts instead of one. If enginemen on switch engines are included in the account engine and roundhouse men, the switching crew of the switch engine should be placed in the account train service. But terminal service is of so distinct a nature that, instead of consolidating its expense with road service, it should be carefully separated.

Examination.—This account is directly related to miles by kind of service. It has very little effect upon other accounts, unless by reduction of pay the service should at any time be so far lowered and demoralized as to increase the liability to accident or delayed train movement, resulting in increased repairs or fuel expenses.

27. TRAIN SUPPLIES AND EXPENSES.

This account includes all those supplies of current consumption incidental to revenue train movement, not used directly on the engine. Supplies differ from material used in maintenance, and in respect to how long a specific application will last. Articles of current consumption, with a usefulness extending only over one run or a very limited number of runs, as oil, waste used in packing boxes, ice, oil or gas for lighting trains, soap, rags, and sponges used in cleaning cars, fuel for heating cars, small tools, fittings and

movable parts of cars when irregularly applied and not at times of periodical overhauling of cars, as bell cord, window sticks, fire protection equipment, links and pins, parts of the train outfit subject to irregular expense by loss or special current wear or breakage, as flags, torpedoes, wrecking frogs, lanterns, lamp wicks and chimneys, water glasses, uniforms and badges when paid for by the company; irregular and extraordinary expenses incidental to train movement, as trackage and pilotage paid to other roads at time of a wreck, expense of transferring passengers around a break in the line by washout, defective bridge, etc., provisions and supplies for feeding passengers and stock of delayed trains, etc. With the material is included the expense of labor, and with those regular forms of expense such as heating, lighting, icing, watering, cleaning, etc., are included the cost of all small tools and incidental supplies.

Comment.—The laundry and supplies of all kinds for officers' cars should be charged to the current expense of their offices, for the same reason that similar expenses are similarly charged when incurred at the office. The train expense of dining cars, or like extraordinary service, should not go into this general account unless the dining car has become incorporated as a permanent and inseparable feature of regular operation, and the question whether it pays has ceased to be a consideration, so that its operations are no longer kept in a separate operating account.

In case of lighting and cleaning and icing very considerable subordinate plants are necessary beyond the small tools of current consumption. It is not defined where the line shall be drawn between those things that are tools and those that are full plants, whose cost goes to capital account and whose renewal goes to maintenance. (Things of irregular application and special use, as grain doors, labor and material for extemporiz-

ing double decking for stock cars are properly train expense and not car maintenance.)

Examination.—Most of the items of this account have a direct relation to miles of specific service. If the wrecking equipment is insufficient on a road it may follow that the engine and train service costs for delayed time are heavy. If some trains are heated from the engine and some from stoves there will be irregularity in this account. The amount of refrigerator service will largely determine the icing expense; the standard of car lighting may vary widely, according to competitive necessities. Inconsiderate economy in this expense may be reflected by heavy damages in the loss and damage account, or undue pinching in the oil supply may result in hot boxes and the increase in train costs due to delayed time. But for the most part the standard of train service cannot vary through a very wide margin, and therefore this account cannot greatly affect other accounts.

28. SWITCHMEN, FLAGMEN AND WATCHMEN.

This account is intended to include all those wages costs incidental to actual running of trains which are not a part of train service nor roundhouse expense, and are not in connection with the telegraph nor station service (except signalmen and station policemen). Such would be switchmen, yard masters and clerks, switch tenders, callers (when special to trainmen and not for enginemen), crossing gatemen and flagmen, station policemen, watchmen, and detectives. These men are employed for the sole purpose of facilitating and safeguarding train movement. They differ from trainmen proper because they are not specifically connected with individual train movement, and further because, outside of the switchmen and yardmen, they are a fixed charge on train movement. Thus they

do not vary directly with the volume of business handled.

Comment.—As it is obviously the intent of this account to provide only for such expenses of moving trains as are not cared for in the previous headings, together with telegraph expenses, it would seem that watchmen and detectives and station policemen were too broad classes to be included without some limitation. Station policemen, for the most part, are for handling the passengers before they get to the train shed and are as proper a charge to station service as the ticket agent who sells the passenger his ticket. Watchmen and detectives should include only those employees who are occupied exclusively about the yard, in watching loaded cars or in locating robberies strictly in connection with train movement. If the switching crew of a switch engine are properly chargeable to this account, the enginemen of the switch engine should be also. While it is true that the crossing flagmen and watchmen and signalmen are direct incidents of train movement, yet they are not directly responsive to the volume of business. They are practically fixed charges to train movement and more closely related to station service than to this account, which is so closely analogous to train service.

Examination.—This account will include a variable amount of commercial service in the placing of cars to private sidings. The fluctuation in the amount of commercial service will be reflected in the switching charges balance, together with its own regular work of marshaling and breaking trains. Taken in connection with some of the items of train supplies and expense it corresponds to the expense, roundhousemen, for engines. It will vary through a wide margin according to the condition of the terminals, which on most railroads are surprisingly deficient or poorly planned. The number of flag crossings differs widely

at different places, and municipal regulations may at any time increase them.

29. TELEGRAPH EXPENSES.

This account includes a form of service that is distinct in a class by itself, because it involves a certain order of skill, requires a limited number of fixed conditions, and for the most part is of one general grade. It is closely allied to station service, but is even more distinctly a fixed charge on train movement and general business of the road. With the telegraph is included the telephone, because of the same general nature in its operating conditions. All telegraph service, also all the telephone service, except that at the general offices, is charged to this account. With the telegraph service for the business of the road is included, at such points as there are joint offices, the commercial business of the associated telegraph company. The expense of all such service, unless specifically shared by the telegraph company, is charged to this account. Telegraph expenses are construed to be the wages of operators, train dispatchers, messengers, clerks and attendants of telegraph offices, together with the cost of heating and lighting, supplies used for charging batteries, current expense of dynamos or current otherwise had, rent of lines, and such proportion of the salaries and office expenses of superintendent and assistant superintendent of telegraph as is borne by the road. The wages of employees, coincidently engaged in the telegraph and other service, as station agent or clerk, are apportioned to this account on the basis of the service rendered.

Comment.—This account includes, first, the telegraphy incident to the direct movement of the trains (excluding signalmen), such as train dispatchers and operators; next the use of the wire by the transporta-

tion department for other business than actual train movement, and then by all other departments; next the rental or operation of indefinitely determined private lines, the telephone expense of stations, and all offices except the general offices, and finally the commercial business of the associated telegraph line at joint agencies. Each of these different uses is subject to considerable fluctuations and may indefinitely increase. The increase may be entirely judicious, but its benefit avails the special department served, and is never placed against the increased expense incurred. This might still not be raised as a very serious objection, until an outside interest, as the telegraph company, becomes the beneficiary. It is true the profits of such business are shared on a fixed basis, but the telegraph superintendent, who has at certain points the option of separate offices, or joint offices at a slight added expense, will perform joint service only at those points where the railroad share of the revenue on commercial business is greater than the increased expense. Within the margin where those options prevail, where increase of expense must be directly offset by increase of revenue, he is practically conducting a separate business; his earnings are not the earnings of the road at large, but of his particular department, and they should be applied directly to the credit of these optional expenses. The net credit only should be shown as an earning and net debit, if the account stands that way, be added to his expenses.

It will not be practicable to charge the service performed for other departments over the regular lines. But the expense of short telegraph or telephone lines, it would be entirely proper to charge to the department served. At least this should continue to be the case until the extended use of this kind of service has become a fixed and inseparable type of the railroad operation. It should be so until it has long ceased to

be looked upon as a mere convenience or special economy. Thus the telephone service of stations is not yet a universal necessity nor even a permanent necessity at all stations, where it may be in present use, and so long as the amount of the use is optional and subject to change it would seem proper to charge it to station supplies and expense, where are placed those expenses that are for the convenience of the agent and within his control.

In apportioning the time of a man to telegraph expense, where any part of his time renders his employment already a necessity, it is doubtful if any real information is had by dividing his time arbitrarily, and certainly none, when the basis of "service rendered" is construed to be relative time employed. But where a basis has been set up it is essential that it be afterward strictly adhered to, except for the best of reasons.

Examination.—This should, for the most part, be an approximately fixed cost from month to month. But its service is open to such irregular demands of departments, other than the transportation department proper, that it is difficult to locate all the effects that follow on a contraction or expansion or inefficient standard of service. Certain parts of its work must be with absolute dispatch and certainty. An order of precedence is generally set up for all business that has access to the wire. Down this order of succession is played out the effect of a congestion of work when the wires are overburdened. Thus the fluctuation in the volume is evened up. It must often happen that business not generally of the first precedence is sometimes of vital importance, and delays occur that are very expensive in their effects.

30. STATION SERVICE.

This account includes the wages cost for those services not directly connected with train movement, but necessary to the handling of the freight and passengers that the trains haul. But it includes only such labor as is required for the necessary and recognized form of service of a public carrier to the community. Extraordinary service, such as a downtown freight or passenger office, does not belong to operation under normal conditions. It is charged to outside agencies. This account necessarily includes all the labor incidental to operation of a station, such as receiving, delivering, billing, routing, reporting freight, quoting rates, selling tickets, calling trains, keeping gates, dispensing information, checking baggage, care of parcel room, keeping accounts, collecting and remitting cash, handling mail, caring for stock in transit, and "working" through cars, care of warehouse, switch lights, buildings, etc. If the warehouse system is in vogue in connection with regular business, it includes all the cost of warehouse operation, as tallyman, weighmaster, etc. If store door delivery is practiced, it includes the labor of teamsters. Where at the smaller stations the functions of several men are united in the duties of agent his wages are properly charged to the station service.

Comment.—Where there is any irregular service for which a charge is had, such as a cab service, warehouse service, parcel room, or eating house or hotel, such revenue should be first applied to its direct expense, and only the net amount (if a debit) passed to expenses under this heading, and the net earnings (if an earning) should be placed in the general earnings of the road. Watchmen at crossings and about warehouses, and depot policemen, are more closely allied to this general class of expense than switchmen, yardmen, and watch-

men where they are placed. If there is good reason for withdrawing the special service of downtown freight and ticket offices from this account, the like extraordinary service of store door delivery or free warehouse service should be charged to similar extraordinary account.

Examination.—This is essentially a fixed charge on transportation or train movement. At the large stations the agent's duties verge close upon those of a superintendent of terminals, and division freight agent, or general agent. The relation at this point between this account and superintendence transportation is very close. The variable extent of the service rendered to the public will very largely affect this account. Stations on the line of road may be too near together, or the extra services performed without charge at a competitive point may be excessive.

A tendency on some roads to place the work of the auditor's office on the agents has often increased this account unfairly.

31. STATION SUPPLIES.

This account includes the cost of supplies of all kinds consumed at stations. It is the cost of material corresponding to the foregoing account for labor which is station service. It will also include the labor incidental to heating and lighting. Therefore it will, for the most part, embrace the expenses that serve the same uses. Primarily the distinction between this and the station service is that this is the expense for material and that the expense for labor. But more fundamentally this conforms more flexibly to actual use. It is more directly within the discretion and control of the agent. It may instantly be curtailed or increased without the wholesale demoralization where labor is involved. Being supplies, it includes only

such material or forms of expense as are of current consumption. The line between what is a current supply and what is maintenance of the depot is confessedly difficult to draw, and at the last must be arbitrary. The classification has defined the repairs and renewals of buildings and fixtures to include repairs and renewals of fixtures and furniture. Station supplies, therefore, would include all other expense connected with the station, save the wages expense of general forces and stationery and printing, which are provided for elsewhere. But in practice the strict letter of the classification is modified. Thus trivial current repairs of fixtures due to special wear, as repairs of a grate, are considered an expense. The repairs and ordinary renewals of furniture, tools, and small fittings are treated in the same way, while the renewal and general repairs of fixtures, and the extraordinary renewal of furniture are construed to be maintenance of the building. In addition to those expenses for uses in and about the depot, this account includes all the expenses incidental to its special forms of service, as the cost of horses, wagons, feeding and care of horses, salary of a veterinarian at stock yards, bedding, feed, and water for stock in transit. Miscellaneous general expenses on account of agencies, as cost of badges and uniforms, premium on bonds when borne by the railroad, will go to this account.

Comment.— Similarly, as would seem obvious, in the foregoing account of station service, the cost of extraordinary services should be carried to extraordinary accounts. It would seem to be stretching pretty widely the license of a statistician to include wagons and matches in the same class of supplies.

Examination.—This will sustain practically the same relation to other accounts as station service, and only differ from it in that it is more flexible.

32. SWITCHING CHARGES—BALANCE.

This account is the net amount paid for switching engines and cars over tracks that are the property of another road or private individual, arrived at by first deducting the charge of our road for similar service. It is an arbitrary charge per car without reference to weight or lading. The expense of this switching is variously borne, according to the competitive conditions that exist. Sometimes it is a mere arbitrary charge collected directly from the shipper as a switching charge. Again it is covered by and included in the freight rate which the shipper pays, but which is not specifically charged as switching. Again it is paid by the railroad, becoming a definite expense to handling that particular line of business. Where two or more roads form a line to profit by through business originating at a terminal where such switching disability exists, they may elect to participate in this terminal expense. In such case the terminal road by the amount of this expense, collected from the other roads of the line, acts merely as a clearing house. The amounts of such collections, of course, would be applied to the credit of such accounts as had been first debited for the expense. But this should be a mere accommodation account and not the expenses item "switching."

Comment.—The tracks where switching charges occur are permanent property, and their use is generally regarded as an exclusive privilege. Whether they shall be used is not an option of the operating officer, but a necessity if a certain line of business is to be handled. There is nothing in the nature of such service performed by other roads that is interchangeable with similar service performed by our own road which may be used to offset the expense. Therefore there can be no good reason for showing this expense at the net

figure. In other words, the switching we may do on our own road has no effect to reduce or increase the switching done for us on a connecting road.

Examination.—This is a traffic expense. It may be considered the commission paid for certain kinds of competitive business. But so soon as it is reduced to a net figure, made out of the earnings and expense of two different things applied against each other, all significance is lost.

33. CAR MILEAGE—BALANCE.

This account is the amount of the net figure of all settlements with other roads, firms, or individuals for the use of passenger and freight cars, interchanged on a mileage basis. The railroads, by agreement, recognize only two classes of freight cars in car interchange. Therefore within each class the settlement is upon the general theory of car for car. While the present mileage basis only imperfectly follows this theory, by making the basis car mile for car mile, the obvious justice of the proper principle has so far forced itself on railway managements that we may shortly expect this basis to be in use, with certain necessary modifications. Cars are of different kinds and serve different purposes, sometimes so exclusively that the cars at hand at any one time may be utterly unserviceable for the business in hand. But, in general, a car is entirely interchangeable, and car mileage is a highly interchangeable account. Therefore there is eminent propriety in showing it as a net figure.

Examination.—This account, from its very nature, has a direct relation to freight revenue, and yet, paradoxically, so variable are the conditions on which this relation rests, that the effect of one upon the other can never be traced. We know, other conditions being equal, that a debit car mileage balance should indicate

a heavy business, which so far has made extraordinary demands on equipment. But the other conditions will never long remain normal, the business may have been ruinously competitive, or the loading bad, or the car detentions excessive, or the car distribution very poor. The mileage rate is constructed on the basis of cost, being the interest on first cost, depreciation, and repairs carried out to a mileage rate on the basis of the average car performance. But the value of a car at any one time for a specific shipment may range all the way from an amount equal to so much of the mileage rate as covers repairs of the car, up to the amount of the net revenue to be derived from that shipment after the direct costs have been deducted, depending altogether on the supply of cars at that instant available. According as supply and demand vary, as they do constantly, the value of its car service to a road will vary. But, meanwhile, the remuneration for cars away from home or the price of cars borrowed remains the same. Hence it follows that a debit car mileage balance has a very variable significance and may be far from having the meaning which it is too often taken to indicate.

34. HIRE OF EQUIPMENT.

This account embraces the payments for hire of equipment, which have not been provided for, by the car mileage account. Thus it will include hire of locomotives and also the hire of cars when outside the general plan of car interchange and on a different basis of settlement, as the hire of a series of cars at a fixed monthly rate or of an extraordinary type of car at a special figure to cover the costs of the special devices in its construction. Owing to the movable nature of all equipment, this account is very properly a net figure, because the two sides of the account are highly

interchangeable; that is, every debit directly tends to produce an offsetting credit, and *vice versa.*

For the same reason, as the car mileage debit or credit balance can have no fixed significance, we may not attach a rigid interpretation to the figures of this account. Generally it is the cost for hire of equipment of special design, to meet the irregular needs of a special line of business, which perhaps might not otherwise be had. Where it is due to the inadequacy of ordinary equipment, if the rate is not excessive it still may not be a bad showing, because the demand for cars may be so irregular that it is cheaper to hire cars to meet the extraordinary exigencies than maintain an equipment which for much of the time is in excess of the demand.

35. LOSS AND DAMAGE.

This account is intended to include all those expenses arising out of loss or damage to freight, baggage, or other goods for which the common carrier is liable, or loss or damage to property along the right of way resulting from irregularities in the conducting of transportation or defects of operation generally. With the direct payments for loss or damage are included all incidental, special costs, as, witness expenses and fees in litigation arising, payments for detection of thieves (not the salaries of regular detectives, which are provided for under switchmen, yardmen, and watchmen), repacking, transferring, or caring for freight irregularly delayed in transit (except live stock when delayed in wrecks, which is charged to train supplies), together with all the regular special costs incidental to this feature of operation, as the wages and expenses of adjusters and special agents. But insurance premiums or legal expenses or court expenses are not included,

Damage and loss may not necessarily be physical, but may be such as is due to change of markets while the shipment was delayed in transit. With the actual losses paid are included the expenses of the office adjusting the claim.*

Together with the railroad's expenses arising out of its negligence as a common carrier are included the cost of settling claims of abutting property holders and interests for damage and loss caused by defects of operation or construction or standard of maintenance, such as stock killed, burning of crops or buildings from fires set from the locomotive, overflow due to insufficient culvert, etc., and all incidental expenses as above.

Comment.—The liability as a common carrier and the liability as an operating concern, to adjacent property holders, differ in the conditions on which the liability is based. But they belong to the same class in that they are both due to the negligence of operation and of the same department of the road, and they constitute a risk incidental to the same form of work. But those liabilities for damage to crops by overflow, or damage to property in the blasting of rock by the maintenance of way department, etc., etc., are incidental to a different form of work that serves a different use, and which is within the control of a different part of the operation. It does not seem proper that it should go into this account, but should be a direct expense to the department served.

When a railroad elects to throw into one grand total the estimated amount of this expense for a given period, and divide it out in monthly installments, or on the basis of train or car miles, the money paid out in this way differs in no respect in the uses it serves, from

* It is not clear that the classification places the claim department under this head of expense, but from the language such interpretation is easily possible.

the money paid directly for loss by accidents as they occur. Yet the classification provides for all such payments to be charged to "general expenses, insurance." The reason for this is not plain. Any employees, as adjusters or detectives, who have become incorporated into the permanent staff of the road, and are not an irregular or uncertain expense, should not be charged to this account.

Examination.—This account primarily should bear a direct relation to train miles. Being purely a contingency account it is exposed to the most extreme fluctuations. The extent to which cars are "worked" and seals broken, the laxity of discipline and the general *morale* of the service, the law-abiding character of the territory served, the extent to which yards are lighted and policed, the character and value of the goods carried, are the obvious general considerations that control loss and damage to freight. But, in addition, there is a constant tendency to increase the carrier's liability, either by more liberal interpretations and even entire disregard of the provisions in the bill of lading, or by a lax enforcement of packing and crating regulations. A rigidly enforced rule for heavy loading of merchandise cars, a false economy in the station expense for seals that shall permit the use of an inferior seal, equipment at such low standard of maintenance as to allow of leaky roofs, an indifferent grade of tallymen at transfer points, are all among the many forms of mistaken economy that must in part be compensated in this account.

36. INJURIES TO PERSONS.

This account includes all payments for injuries to persons, whether by award of court, or private settlement, or as mere gratuities. It also embraces all incidental costs arising from the injury of persons, as their

transportation, hospital and medical expenses, board and funeral expenses, coroner's and witness' fees, but not lawyers' fees or court expenses, which are charged to legal expenses. It will embrace the salaries and expenses of administration of any permanent salaried surgical staff and of others employed in the adjustment of claims.

With injuries that are purely physical are classed those irregularities in the treatment of passengers that are construed to be inconveniences, discomforts, invasion of rights, or indignities such as ejectment from the train, putting passenger off at wrong destination, physical violence by trainmen, etc., together with all incidental expenses as above.

This account includes all personal injuries whether to passengers, trespassers, the public who may not be trespassers, transportation employees, or the employees of any other department of the railway service.

Comment.—When there is a regular surgical staff that constitute a fixed establishment, it is questionable if they are not of the nature of a general administrative expense to be included in superintendence. But all surgeons of irregular employ, or paid in fees, belong strictly to this account. If it is proper to include other fees incidental to this expense as being irregular charges special to this feature of operation, it would seem that the legal expenses that are paid by fees either to lawyers or courts, being irregular expenses, special to this account, should be charged to this account.

Although the risk assumed by the railroad is different in the case of passengers and in the case of trespassers and the general public, yet both are a common incident of operation, that has a direct relation to the amount of train mileage. They properly come under the same class. But the injury to an employee not engaged in transportation, as a bridge carpenter falling from a bridge, or shop hand losing a finger at

the bench, is an incident to the particular service on which he is engaged, and should properly be considered as one of the elements of its cost, both because it had not occurred, except for that particular work and also because it is largely within the regulation of the service where engaged. Injury to a transportation employee on the line of road in the ordinary course of transportation belongs to that great class of casualties incidental to train movement, which is a sufficiently universal and inseparable feature of railroad operation to justify an expense heading.

Examination.—This account will be largely affected by the maintenance standards, both in roadway and structures and in equipment: the use of block signals, type of bridge structures, condition of track, height of overhead bridges, use of air brakes, condition of brake wheels, hand holds, and running boards on freight cars and policing of crossings in the city. The very vital factor is of course the discipline and *morale* of the train service. But costs that raise the standard here, and the false economies that tend to lower it, cannot be directly located in the accounts. Expenses of club houses, reading rooms, and gymnasiums are among the forms of outlay to assist in maintaining the standard of the service, but the effect can never be directly measured. One road even goes so far as to employ a chaplain, and a great many contribute liberally toward the Y. M. C. A. as a definite business policy.

Quite as important as the number and actual nature of the accidents resulting in injuries to persons, is the tone of public sentiment as registered in the awards of damages by the courts which define the railroad's liability most capriciously. We recall one instance where the plaintiff, in a moment of forgetfulness, had allowed the conductor to kiss her. She later learned that this experience was a very good asset if handled

by the proper legal talent, and sued for personal injury to the amount of ten thousand dollars. The railroad was actually mulcted of several hundred dollars by decree of court. The expense was charged to this account. Delays, resulting in missing one's mother-in-law's funeral, or even the appointed hour of one's own wedding, are computed at definite dollars' worth of mental distress and anguish, seemingly according to some tariff of afflictions and affections.

37. CLEARING WRECKS.

This account includes all those expenses for restoring transportation after a wreck. It embraces all the costs directly or indirectly incidental to a single wreck or wrecks in general, such as reloading and transferring freight, mail, baggage, and express, cost of temporary track around the wreck, watching and clearing up wrecks, meals or board for passengers, feed for stock delayed by wreck, and the regular cost of any standing wreck crew, their small tools and supplies; but it does not include the payment for any damage arising from the wreck nor the cost of full restoration of equipment or track that has been damaged, nor the interest on first cost, the depreciation and maintenance of a permanent wreck car and outfit. The removal of a wreck from the track to open up the line would be construed to be wrecking, as also the loading and removal of wrecked cars and locomotives or any temporary repairs incidental to getting them back to the shop.

This account is to provide for those extraordinary expenses resulting from wrecks which are defects of operation, as distinguished from those costs due to irregularities in the movement of trains, caused by defects or contingencies of maintenance, such as slides, washouts, obstructed track, defective bridge, etc.,

which are provided for in train supplies and expense. Wrecks resulting from such causes or from defective rolling stock are the fault of transportation, which should have avoided disaster although they cannot avoid delay.

Comment.—The cost of maintaining a wreck car is a direct incident of transportation, and should go, as it does, into the general costs of maintenance of equipment. Small tools and minor detachable parts of the wrecking outfit, as links, pins, rerailing frogs, etc., are properly expense, and not maintenance, and should go to this account. So also are all supplies, as oil and waste, together with the train service and expense of moving the wrecker.

Examination.—This belongs to the class of contingencies that primarily have a direct relation to train miles. It differs from loss and damage and injuries to persons, which extend to include consequences more removed, such as the settlement of damage to goods of wide range of value and for injuries to persons whose claims are of great irregularity.

If a considerable amount of money is invested in the wrecking outfit, the direct expense of wrecking should be much reduced by the use of such greater facilities.

38. OPERATING MARINE EQUIPMENT.

This account includes all the operating costs incidental to water carriage, as distinguished from the standard type of railroad operation, which is by land. Throughout the classification, all operation by water is treated as if it were a separate business. Such operating expense as had not been incurred by the railroad company, if the water transportation had been performed by a separate company, would be charged to this account. Where the expense is direct and not

joint its charge is a simple matter. But in case of marine carriage that is merely the link in a through line of water and rail, there will be a large body of joint operating expenses, such as the general agent, station agent and staff, and the station labor, which must be apportioned on some equitable basis among the appropriate heads of the railroad's regular operation and this account. This, for the most part, is a matter of specific determination.

Operating expense is distinguished from maintenance without difficulty, in case of the boats and wharves, but in case of small current repairs of fixtures, and large repairs and renewals of furniture and fittings, the line is not easily drawn, and must at the last be enforced by distinctions that in themselves are purely arbitrary. Thus, cost of new awnings at a dock office and their overhauling at times of painting or general repairs of the building, would be considered maintenance, while their current repairs and partial renewal would be strictly expense.

With the direct current costs of operating steamers, ferries, transfer boats, canal boats, docks, wharves, etc., will be included the customary marine charges, as clearance and custom dues, health and steamboat inspection, dockage, towage, lighterage, etc. It will embrace superintendence, as agents, port captains, port stewards, also clerks, porters, coopers, warehousemen, laborers, etc. It will include all incidental expense for heating, lighting, policing, etc.

Comment.—The marine operation must be a considerable and tolerably permanent feature of the railroad's operation to justify a charge to this account. It must be incidental to transportation and not maintenance. Thus the skiffs in a pleasure park or the mud scow used in making cofferdams or repairs of a pier, are not marine operation. But a water terminal, even though the railroad do not operate the connect-

ing boat line, if it is for the handling of through traffic over a dock or wharf, and has no local business, belongs to the class of marine operation, in so far as it makes use of and incurs direct expense for wharves, docks, and water facilities.

Since this is such a distinct feature of operation as to justify a separation through both the maintenance and operating accounts, it should bear all such expenses as are in any way special to it. Such would be local telephone service, and all stationery and like supplies consumed in its direct operations, but not way bill or reporting blanks that directly serve a joint use. So also it should bear its own insurance expense.

Examination.—The dock and wharf expense will be directly related to tonnage, while the steamer expense will, like similar cost for rail service, bear an approximate relation to ton miles, and more direct relation to boat miles. This account is so distinctly independent that it cannot affect nor be affected by other expense accounts to any degree worth notice.

39. ADVERTISING.

All forms of attracting public attention, stimulating general interest, soliciting inquiries, and publishing information which are more than bare announcement, or cultivating friendly relations in expectation of patronage, are in the nature of advertising. Thus the posting of a schedule at a station or the services of a ticket seller, the display of freight tariffs, perhaps the simple insertion of train schedule in the local paper, where on the basis of mutual exchange of courtesies, are strictly regular and necessary features of transportation service. But the extensive and systematic distribution of timetables at all public places and in foreign cities, the paid insertion of train schedules in all the local papers, and of squibs, personals, and descriptive articles, the

general distribution of maps and signs and special announcements, and the sending of traveling passenger agents to scatter information and posters, are advertising. Advertising essentially involves the notion of cultivating a demand that does not exist, as distinguished from announcement which simply explains and specifies the supply to a demand that already exists. Thus it will include the salaries and expenses of any staff directly engaged in increasing the demand for the road's services, as traveling and city passenger and freight agents, and land and immigration agents, but not those employees or expenses incidental to outside agencies, which are provided for specially by a separate account. It embraces the cost of advertising devices, souvenirs, a literary bureau, newspaper announcements, and other insertions, patronage of fairs and other public occasions or enterprises, as premiums offered, general donations subscribed, entertainment or gratuities for influential parties or public agencies that may control business, and all incidental expenses for postage, express, or messenger, cab, or telegraph service that can be specifically located to this account. It does not include notices of stockholders' meetings or like financial announcements, which are of a general character and are not of the nature of advertising.

Comment.—Advertising is always for a specific purpose, or for a definite kind of demand which it is desired to cultivate. We may advertise for passenger traffic, freight traffic, for all traffic, for settlers, for purchasers of railroad lands, for purchasers of specific articles or properties, apprehension of thieves, train robbers, or miscreants, for tender of supplies or bids, etc. These plainly serve different uses, and those last named, because the possible stimulation is not great, and because what is usually the supply has become the demand, verge closely upon the nature of simple announcement. The great use of advertising is for the

stimulation of current traffic. The great body of the expense comes under this description, which is a general and permanent feature of transportation operations. But other forms of advertising that belong to single parts of the operation, or are concerned with only part of the property, should be charged specifically to the accounts served.

Much advertising is paid for in services, which have a public money rating, which also may have a direct money cost, and which may involve a sacrifice of possible revenue, in performing without charge a service for which there existed sufficient demand to pay for in full. It would seem proper to charge to this account the direct cost of such services given for advertising as have a direct cost, and to charge the revenue sacrificed, at one or two conventional rates, according to the class of conditions attending. But half-rates to clergy, schools, churches, or public charities do not belong to the class of concessions for advertising.

Examination.—This is an exceedingly uncertain account. We are only sure of so much as actually gets into it. There is a vast amount of advertising by indirection, which is included in the regular expense of other accounts. The policy of cultivating popularity may come in to affect the cost of nearly every feature of operation. It is closely incorporated with the standard of service rendered the public, which is constantly exposed to progressive change. The maintenance of a very fast train, the beautification of station grounds, the elaboration of station architecture, the luxurious equipment of certain special trains, are all in the nature of advertising, so far as they offer a standard of service that exceeds the general standard of the road.

The policy of advertising is erratic. The amount spent cannot be conclusively measured against any standards. Local conditions and changing conditions,

as well as special policies, will determine it. For the most part it represents the tremendous wasteful expense of competition. But it only represents it, for, as noted above, this expense is distributed over the whole field of service performed.

40. OUTSIDE AGENCIES.

This account is intended to cover all those fixed expenses directly incidental to cultivating competitive business. It is distinguished from station service because it is not a part of the physical service of transportation, but purely an extraordinary service performed at extravagant cost. It seldom even has the virtue of an added service at all, being an expense without producing any value to the railroads as a whole or the community. It differs from "commissions" in that it is practically a fixed cost from month to month, and from "advertising" in that it is the direct expense of getting the business and not of advertising for it at long range.

The establishments that will incur an expense of this description are those soliciting agencies at competitive points on the line of road known as "downtown offices"; and not connected with the regular agency, they are next the agencies sustained by the road individually at points off the line, which are gateways to competitive traffic; again, they are such foreign agencies as are sustained jointly, known as dispatch lines or transportation companies, and finally they are those agencies that are forms of co-operation among competing lines to regulate and limit competition, as traffic associations, inspection and weighing bureaus, since these are incidents of competitive business. But a demurrage bureau, though it in many ways serves the same ultimate uses, is considered as a transportation and not a traffic incident, and the expense of admin-

istration is charged to "superintendence, conducting transportation" or "other expenses, conducting transportation."

When the outside agency is a co-operative fast freight line that owns cars and undertakes some of the features of actual transportation, in addition to mere solicitation, such parts of their expense as correspond to this service are chargeable to the regular operating accounts which are served. Thus the proportional expense of car maintenance to each road is a car repair expense, and the supervision of car movement is a superintendence conducting transportation expense.

With the agency are included not only the salaries and expenses of its staff, but all office expenses for heat, light, furniture and supplies, rent, telephone and telegraph service where paid for by the message, stationery, licenses, etc.—in fact every form of direct expense which they may incur. But there are not included the proportional part of undistributable general expenses of the road, such as superintendence, a rent charge for a building owned by the road, the use of its telegraph facilities or privileges, etc. Of course, where the outside agency is a joint establishment, any contribution of the use of buildings or facilities of the road should enter as a consideration or direct charge in making the joint arrangement.

Comment.—The rental of telephone lines would seem to accord with the general tenor of the charges to this account. It should be specifically included here as an exception to the general telephone account in telegraph expenses. Where business is paid for by commissions, but with a guaranteed minimum monthly cost, the amount of the monthly guarantee should be charged to this account and the residue to the account "commissions."

The passenger department is to a very large degree the advertising department of the road, and very prop-

erly the salary of the traveling passenger agent is charged to advertising as a general rule. But where his business is more strictly direct solicitation and actual competitive movement of passengers, he belongs more especially to the class of outside agents. To further his main purpose, he may be a ticket seller and set up an information bureau, or perform other special services for the convenience of his patrons. In such case he is strictly an outside agent.

Examination.—This account will not have much regularity among different roads, since traffic exigencies are so various. It is strictly a competitive expense, with advertising and commissions. It should have a general reference to the amount of competitive traffic, but will not follow the fluctuations of this traffic through short periods of less than a year. Aside from its real irregularities it is exposed to apparent irregularity, due to the different form of the traffic organization on different roads, resulting in confusion in charging to this account. Thus, on the one side it touches the account "station service," at the larger agencies, and on another side "superintendence, conducting transportation," in the case of the superintendent of terminals, general agent, etc.

41. COMMISSIONS.

This account is to include the extraordinary and irregular costs of securing specific business that could not otherwise be had, by payment of commissions. It is defined not to embrace agents in the regular employ of the company, though paid on the commission basis, since this is merely a method of paying for a regular and essential feature of operation. So also outside agencies are excluded on the theory that their entire service belongs to the employing company, and their expense is approximately a fixed outlay from month to

month. Owing to the reasonable constancy of business, this expense can be paid on a commission basis. But the latter distinction becomes difficult to follow when the outside agency is a mere general soliciting agency for a number of roads, which deliver such business as it may control for each of the roads concerned, and whose expenses are apportioned to each road on the basis of the tonnage delivered. The last class, perhaps, had best be included in this account, together with those general agencies that are independent of any single railroad company. These are practically transportation brokers, who sell such business as they can deliver, on the basis of a regular commission. When instead of such general brokerage agencies we have individuals, as ticket sellers, passenger agents, and others of foreign roads who avail themselves of some general standing offer for all passenger business routed from their territory over our road, we have come to what is generally understood by "commissions." In case our outside agency is paid on the commission basis, but is guaranteed a minimum monthly allowance, when the commissions do not reach this amount the expense would be of the nature of an outside agency charge, but all surplus over and above the guaranteed minimum payment should be charged to commissions.

Comment.—The expense of drayage equalization is entirely after the nature of the costs that enter this account, and we believe should be included. It differs from store-door delivery, because that is a general feature of all railroad service at that place, but this is an expense special to the unfavored road, and more especially a direct payment for business that could not otherwise be had. Switching charges paid are of the same description. It may also be questioned if any excess mileage rate, paid for cars of special construction owned by shippers, should not be charged to this

account But direct cash rebates which involve neither the notion of the agency of a third party, nor special extension of the service performed for the regular tariff, should be considered as rebates to be deducted directly from earnings, since between the intake of the gross rate and the outgo of rebate there has been no intervening service whatever.

Examination.—This account differs from outside agencies in that it is very fluctuating, varying instantly with the volume of competitive business when the rate of commissions is fixed, whereas "outside agencies" does not respond at once to the fluctuations of competitive business. In fact it is sometimes an indication of wise management when the expense "outside agencies" varies inversely as the competitive business.

Commissions are like advertising in this respect that we are only sure of so much as actually gets into this account. This is of course not true of actual cash commissions, but it is true of the great body of closely allied expense, which properly should be charged here. "Switchmen, yardmen, and watchmen," "switching charges balance," "station service," "car mileage balance," "station expense," and "other expenses conducting transportation" will bear the brunt of such irregular expense.

A great part of the competitive business of a railroad is gathered up and delivered to it by its connections, generally on the basis of mutual exchange of like services, thus involving no cash payment. When the service or consideration applied by a railroad, in such exchange of benefits, is in the course of its regular business and involves no direct expense that can be specifically located, it bears no relation to cost. But when as is often the case a main line supports feeder by monthly payment of money, or by relieving it of some part of the joint expense, we have an outlay that is very closely allied to the generally accepted notion

of "outside agency" or a commission. If such expense is not charged to this account or outside agencies it should be examined in connection with these accounts.

42. STOCK YARDS AND ELEVATORS.

This account contemplates a feature of operation that, up to a degree, is universal on railroads, but which, in certain territories having special single lines of business, becomes highly specialized and assumes extraordinary proportions outside of the general scheme of ordinary operation. In such cases it extends to forms of service not a part of transportation proper, where it is placed on a separate financial basis. Being supported by an arbitrary in the rate, or a direct collection for service rendered, its expenses are applied directly to its earnings. They are not a part of the regular expense of the road. On the other hand are likewise excluded from this account the expenses of line-of-road stock yards, which belong to the general type of service rendered and are not, as at terminals, highly specialized.

The expenses are for wages, supplies, and all direct costs. But stationery and local telephone service are not specifically included.

Comment.—Stock yards and elevators only are specified in this account, the theory being that these are extensions of the regular service which are sometimes conducted as distinct and separate business by other parties than the railroad. The operating marine equipment is an analogous account, differing from this in that the field of other business here encroached upon is water transportation and not warehousing of goods in land traffic.

It differs from competitive extensions of service, such as are provided for in outside agencies and per-

haps in commissions. In those accounts the extension of service, there embraced in transportation, is not an encroachment upon any existing business already performed by other parties than railroads.

Stock yards and elevators are the special features of the business in certain large sections of the country, but in a cotton territory it may sometimes happen that a cotton compress is operated under precisely similar conditions, or tobacco is extensively warehoused at terminal depots, or pig iron is stored in a pig-iron yard at terminals indefinitely for more favorable markets. Similarly the operation of a pleasure park and picnic grounds on any extensive scale are an extension of the service by invasion of the province of regularly established business, though not of such magnitude. But the operation of eating-houses and transient hotels at points essential for the railroad, where the conditions would not tempt private enterprise, has carried us into doubtful territory.

The extent to which these facilities are self-supporting, when operated as separate enterprises by the railroad, may vary greatly. They may be a distinct property, having a distinct balance sheet and separate management, or a distinct balance sheet and the same management, or the same balance sheet and a separate income account which does not embrace all the fixed charges of the investment, or only a separate operating account. But so long as they have any considerable direct income which is applied to the extinguishment of their direct expenses and the remaining deficit is an inconsiderable amount compared with the total of the direct expense, these are considered as a separate business. In such cases only the net deficit would go into this account.

Examination.—This account comes at the point where adjustments in the type of service rendered, to meet the existing conditions and physical character

of the traffic, and usage, and competition. Among these conditions will be wide diversity over the country at large; hence there will be wide variation in the amount of this account among different railroads. But on any one railroad or in a given territory, there should be tolerable regularity based on the volume of business. The account that will be most affected by this service is station service and station expense. Rents of buildings and other property will sometimes absorb expense that would seem more properly a charge to this account.

43-44. RENTS—GENERAL.

A railroad is primarily supposed to be owned and to be supplied with all the proper facilities for regular operations. But where defective, the part wanting is supplied by rental.

The rental of an entire railroad property is equivalent to the interest charge on the first cost, and therefore is not charged to operating expenses but to income direct.

The term " rent " is used with considerable latitude. It may be strictly rent, which is a charge for the use of property, but it may be paid on the calendar basis, or as a toll on a wheelage basis, or a proportion of a fixed charge on the basis of tons or cars handled. It is quite as often used to designate charges that include both rent and service. Especially does this occur at a joint station, owned and operated by one of the parties, the service and rent being charged in lump at some agreed arbitrary to the other parties. Theoretically we should separate such expense to its proper accounts. For our purpose, rent is those fixed costs which are beyond the current control or only very indirectly and remotely within the regulation of the operating officer. If the payment be on the calendar

basis, the expense at any one point is not within control except by cutting it off entire. If on the car, train, or ton mile basis, it is determined by the volume and exigencies of business, which may be only in part regulated by the methods of operation. But if it is the proportion of a joint expense, that is, under a joint administration, then it is proper to distribute the cost of such services as are included, to the heads of account, because they have ceased to have the certainty and inflexibility of rent. The charge to rent in such cases will only be the interest on first cost, or such expense as represents this.

The classification specifically includes in this general rent account depot grounds and buildings, union depots, offices, docks, wharves, ferry landings, elevators, stock yards, fuel yards, and tracks "for running trains," tracks for commercial and maintenance of equipment purposes at yards and also terminals generally. It specifically places in other accounts, rentals of entire railroad properties, temporary track rental at time of wrecks or washouts, rent of buildings used for outside agencies, rental of rolling stock and boats and floating equipment, rent of quarry, water rights, and like privileges, rent of telegraph and telephone lines. Such rents as are not specified fall to this general rent account of the road, which is under the two general heads of tracks, yards, and terminals, and buildings.

Comment.—It would seem that this account is accorded a significance not justified by the best principles of classification. But it is so firmly planted in long usage and general favor that any criticism is at great hazard. The purpose of a classification is to split a gross expense into its parts according to their several different relations to the general volume of business. Some parts are related directly, as train service; others more remotely, as station service; and some irregularly in single instances, but within confined range

through a long period, as repairs to a building, and others still are highly adventitious, as a gratuity to a sectionman. All of these expenses bear a relation, real or supposed, to the volume of business, as a first cause, but are immediately related to that part of the general type of operation which directly incurs the expense. By opening a general rent account we are assuming that the rental feature of an expense is the largest cause for the expense, next to the general volume of business which first made it necessary at all. It is as if the cost of locomotives and ticket cases made at the shop was charged to maintenance of equipment locomotives, and maintenance of way and structures buildings, respectively; but if these were bought in the open market we charged the cost to "purchase account." If the analogy is denied let us inquire more fully into the nature of rent as used in this account.

The essential nature of rent is that it is inflexible. Coincident is the notion that it includes a possible profit to another party that had been saved if the property had been owned. But in case of most fixed property of railroads, it represents such large investments that the rental is not generally more than a fair income on invested capital. As railroads are operated this profit had otherwise been paid as interest on the cost of property owned and mortgaged. At least it can never so far become the prevailing feature of all rent expense as to make it the basis for classifying all expenses paid by rent.

On the other hand the inflexibility has reference to the immediate use served, and perhaps is related only indirectly and most remotely to the general volume of business. To gather into one head, that shall represent a certain relation (in this case that relation is inflexibility) to one thing, a lot of items for the reason that they all bear that relation to miscellaneous other things, defies the first principles of all classification,

And yet this is what is done when we throw into one general rent account the great body of rents on the road.

And further, if this common relation were true, inflexibility is a thing of all degrees, depending on the different length of the lease and the indispensable, general nature of the service rendered. These elements enter in all diversity of degree, so that it is inconceivable that there could be any common standard of inflexibility among them all by which we may group them.

In other words, rental is the mode of an expenditure itself. It is a mode that for the most part is inconsequential as affecting the amount of the expense. If it be true that it includes the notion of profit that might have been saved, this is not a sufficiently universal and significant feature to justify a classification of expenses under this head. If it is inflexible, this inflexibility is in the rate of charge and permanence of widely different items, serving all kinds of uses. When all such items are thrown together indiscriminately, it is not the rental and inflexibility feature that determines most largely how many of each kind of item shall enter this account and so determine the amount of it, but the extent to which they are used.

When the rental is for an entire road, it is recognized as indispensable absolutely, being the condition precedent to operation. It is then withdrawn from operating account. So far, the principle is applied that such charges as are distinctly of the nature of rent do not belong to operating expense. Those that permit option in the amount used are proper operating expense, but should be located with those accounts which derive immediate benefit, like any other costs. This principle is partly acknowledged in case of water rights, quarry rights, etc. Where such rents are for the benefit of such highly

separable or distinct parts of operation as operating marine equipment, outside agencies, stock yards and elevators, telegraph expense and advertising, they should be charged entire to the account benefited, even though the charge include costs that had been borne by other departments if the property had been owned. But in case of rents for regular operating accounts, it would be proper to relieve the account benefited of so much of the expense on account of rental as the maintenance department will assume, as being the estimated amount for which they could maintain the property rented.

There still will remain a class of rents that do have a tolerably common inflexibility to the central feature of operations, which is train movement. For these there should be a general rent account. Such would be rents of line-of-road depots and yards and similar facilities at smaller terminals, where not absolutely indispensable to operation or on long, irrevocable leases. It should also include irregular trackage facilities at terminals, also motive power facilities. But rent for water stations, or fuel stations, except where inseparably connected with the expense of a general rented terminal, since their arrangement is highly flexible, should be shown as water supply and fuel expense costs respectively.

There may still remain lump rent charges which it is impracticable to identify against the detail accounts benefited. These will enter as unlocated items in the general rent account.

Examination.—This account, being the cost of completing the existing standard of the property up to operating requirements, where it is deficient, may affect almost every maintenance of way and structures account. Because it may include service as well as rent it may affect most of the transportation accounts. It is exceedingly irregular among different roads, but

should have almost the regularity of a fixed charge on the same road.

45. STATIONERY AND PRINTING.

This account includes all stationery and printing for the transportation department, except that used for advertising and outside agencies, with a possible exception also of that used in superintendence of telegraph. It does not embrace the stationery used by the auditor in handling figures of the transportation department. The account not only includes stationery and printing used in and about office work, but tariffs, circulars, employees' time-tables, and tickets and way bills and postage. With what is strictly stationery and printing are included all the small desk conveniences, supplies, and office facilities that are not usually classed as furniture, such as copying brushes, letter-presses, cyclostyles, typewriters, adding machines, etc.

Comment.—The stationery used about an office is as much a current expense and in no way distinguished from the heating and lighting of the office. It would be quite as reasonable to lump into one account all the coal consumed in stations, caboose cars, division offices, general offices, outside agencies, watchmen's boxes, and signal towers into one account, as to draw together from all its irrelevant uses all the stationery used in the transportation and traffic departments into one account. Our account means absolutely nothing. It is as if all the iron used on the road in any one month were charged to an "iron consumed account." With the recent development of office conveniences to quite elaborate mechanical contrivances, the obsolete character of the account is further apparent. Add to this same account tariffs, time-tables, tickets, way bills, etc., and all pretense of meaning is gone. The only

proper items for such an account as this are tariffs, tickets, way bills, public time-tables (not for general distribution), employees time-tables, classifications, notices—namely, large lines of printing and stationery supplies. These serve the same general use or class of uses which is the direct handling of business and does not extend to include a variety of detail uses in all degrees of indirect relation to that business. There is only one thing to be said in extenuation of the existing classification, and that is that on a road using a great body of blanks which it is constantly changing there is a great waste of stationery by "scrapping" good supplies which is beyond the control of the individual consumers and is a general policy. Where such policies result in greater waste than is possible in the course of ordinary consumption there would be justification for the account as it now stands. But it would be a reckless management that indulged in such policies.

Examination.—This account has practically no meaning, as it is not directly subjected to any general causes except extensive changes in books and blanks, or general reissue of tariffs and employees' time-tables.

46. OTHER EXPENSES.

As its name implies this account embraces all those charges which do not fall naturally under the regular heads. They are gratuities to employees of the transportation department, expense of reading rooms and Y. M. C. A.'s. They are expense of extraordinary bulletins or advertisements of the transportation department, as offers of rewards for apprehension of miscreants; they are dues of transportation associations, officers' associations, and sometimes of demurrage bureaus.*

* Practice differs—the expense of demurrage bureaus is variously charged to superintendence, other expenses, and car service.

They are extraordinary fees or bonuses, incidental to transportation, as custom house inspector's fees, also special detective service and strike expenses.

Comment.—The general characteristic of these expenses is irregularity. They bear a more or less indefinite relation to the whole of the operations, not to any one part.

Examination.—The irregularity of this expense makes it impossible to judge of it as a whole. It should periodically be delved into systematically and each irregular item of considerable amount specially examined.

GENERAL EXPENSES.

47. SALARIES OF GENERAL OFFICERS.

The general officers are those officers whose services are not special to one department, such as president, vice president, and secretary, and assistant to the president, and such of the directorate as may be on salary.

When it happens that a vice president is confined exclusively to traffic or transportation or maintenance, the theory on which he is included among the general officers would be that he is paid a special salary, stands in a high order of succession, is in full conference with the president, with no other superior, and has duties which are rather in the nature of a special assignment in a general province.

It next includes officials of duties, general to several departments, as the legal, operating, auditing, and general property officers.

Legal officers are those whose services are a regular salaried expense, and general for the entire property and not special to geographical divisions or other separable parts. The titles of such officers are usually general counsel, assistant general counsel, and general solicitor.

The operating officers are those whose duties include both transportation and maintenance, with titles variously of general manager, assistant general manager, and general superintendent. If their authority does not include maintenance they are simply transportation officers, and their salaries should be charged to superintendence conducting transportation, since they are not a general expense.

The auditing officer may be comptroller, auditor, assistant and special auditors (except the auditor of motive power and traveling auditors). He discharges the distinct function of auditing. To audit is to identify every transaction on the road with the authority covering it and put the seal on all such that are duly authorized by entering them on the general books of the company. In this way he permanently incorporates their effect with the general property. The auditor's duties are largely an amplification of those of the secretary, as custodian of records, and his salary is therefore distinctly a general expense.

Finally there are the general officers, who have the custody of the general property and of property and supplies of general circulation and use. Such are the land commissioner, treasurer, assistant treasurer, local treasurer, purchasing agent, general storekeeper, and stationer.

There is also included the chief engineer.

Comment.—This account includes salaries only, because the salaries of officers cannot be measured against a general market rating, as their services are special and extraordinary. Each salary is in the nature of a special disbursement and should be exposed to special scrutiny. It includes only the general officers of general services. The line between a general officer and a subordinate is necessarily arbitrary. The subordinate gets a smaller salary and so belongs to a more general class. It may be questioned if a stationer is properly an officer of this class.

As it is distinctly confined to those officers who have general services, we do not see why the chief engineer, whose duties are confined to maintenance of way and structures, should be included.

Where the road carries any employees' relief agency or insurance, or its own fire insurance, it is customary to include in this account the salary of the officer in

charge, unless the funds are made to bear all their own expenses.

Examination.—While this is a very important account, so many considerations may enter that little generalization is possible. The miles of road, tonnage, class of business, and financial stability of the company all must be considered. The organization of different roads differs so that the real discrepancies in this account are exaggerated by apparent discrepancies. Especially is this true in diversity in the number and duties of the vice presidents. The difference between a vice president and an operating officer is largely nominal, amounting in the practical outcome to little more than a difference in the salaries paid.

Further, since this is the highest service of the company, united with the actual duties is responsibility, which is an indefinite quantity. Some part of the salary paid must be considered necessary as simply to give dignity and character to the position. It is at the pinnacle of the service; all the lines of expectation from the lower grades of the service must be trained on this point. By far the greatest reason that can be adduced for gradation in salaries is the stimulation it produces throughout the entire body of employees. It is in part the premium on all antecedent service that the official has performed. The career and reputation of the man thus figure no less than the present immediate value of the particular service he renders.

48. SALARIES OF CLERKS AND ATTENDANTS.

This account includes the salaries of the staffs of assistants and clerks of all general officers, together with all general office employees of any kind whose service is for the use of the general office (except engineers and firemen of stationary engines for heating and lighting). It will also include all wages cost for

the personal convenience of and attendance upon the general officers, such as porters and cooks of officers' cars, while in the service of the officer. Thus it includes the offices of the president, vice presidents, secretary, comptroller and auditor, general manager (as described in the foregoing account), chief engineer (but not the offices of the division and resident engineers, which are charged to roadway), treasurer, including the cashiers and paymaster, the purchasing agent, general storekeeper, and stationer. To these are added the tax agent.

Comment.—For the most part the line between the staffs of the general offices and division and other offices is clearly drawn. The nature of such expense is plainly general. Duties performed at a general office are largely determined by their character rather than the choice or methods of the officer in charge. The difference between the geographical division, plan of organization, and the departmental or highly centralized plan is not so much in the distribution of the work as in the distribution of the discretion and authority. In the latter plan the authority is all lodged with the general office, but the great body of work is from its nature geographically distributed, except the purchase of coal and supplies. This work goes on about as before, with the difference that it is under traveling inspection, instead of resident superintendence. But there is one class of work that can be highly concentrated or widely distributed according to the methods in use. Since the plan of organization is not different in either case, and the extent of centralization is a matter of degree, and not one of two distinct types, it is seldom noticed. This work is what is commonly called auditing. Coincidently with his work as auditor, our officer has come to be accountant and then statistician. Auditing is a distinct thing, which cannot be distributed, but accounting and statistics, which

have come to constitute the great volume of his work, can be done anywhere. Accounting enters every form of operation in some way, if only in the making of payrolls and distribution of the money on them. Every day, with larger operations and more highly centralized organizations, statistics enter more largely into every detail of work. All of these figures finally come to the auditor. The line where he shall come in and take up the work and bear the expense for labor and supplies is undefined. Thus he may elect to have the freight accounting largely done at station agencies instead of at his office, or he may arrange to work up the payrolls, stores accounts, etc., at the general office. Added to this the auditor's functions as an accountant have not yet been clearly defined. On some roads he includes the claim department, the car accounting, and practically all the statistics of every nature done on the road, and again he may be little more than secretary or treasurer. But we do not think the uncertainty is so great as to justify the classification of the auditor motive power expense in maintenance of equipment superintendence.

Examination.—According to what plan of organization prevails the general office account will be light or heavy at the expense of the accounts that included resident superintendence costs. If the auditor has his figures largely worked up to accounting totals before they reach his office, and if his department also embraces the office of the freight claim agent and car accountant—the station service and expense, the superintendence and stationery and printing, conducting transportation and maintenance of equipment will be affected.

49. GENERAL OFFICE EXPENSES AND SUPPLIES.

The two foregoing accounts provide for all salaried expense of the general office. This account is intended to include all remaining expenses, except stationery. Thus it will include supplies used in heating, lighting, cleaning, and caring for general offices, expenses and supplies of officers' cars and pay car while in official use, and all personal expenses of officers or employees which are paid by the company. It accords with the spirit of this account to include the cost of any irregular and special labor for the convenience of the office, not done by a regular employee. Such would be cleaning off snow, putting in coal, sprinkling street, extraordinary janitor service, etc. The repairs and renewals of furniture and fixtures are charged to buildings, maintenance of way and structures.

Comment.—It would seem that all expense, regardless whether labor or material, that is directly incurred for heating, lighting, and cleaning and caring for the building and rendering it comfortable and convenient for office purposes, is a distinct thing from salaried expense of the staff who work there. If that is so the wages of janitor, elevator boy, and stationary engineer should be charged to this account.

The current repairs, and irregular renewals of furniture and current small repairs of fixtures as result from special wear, should be charged to this account instead of maintenance.

The principle of charging to rent account all rent paid, regardless of the purpose served, or whether it includes service as well as rent proper, may relieve this account of expense which properly belongs here. Also the principle of allowing the maintenance of buildings serving secondary purposes, as offices and shops, to go into general maintenance account without distinction, makes it possible to greatly enlarge general office fa-

cilities without any corresponding increase in this account. With maintenance, in all the relations it sustains, should be included the insurance.

Insurance of office records, contracts, and furniture is distinctly an office expense.

Examination.—This account registers the cost of office convenience and comforts and the incidental expense of general officers and their staffs. It is properly separated from salaries, because more flexible. For the most part these comforts are, however, the mere necessary facilities for working conditions, and will not show great irregularity. The same causes that may affect the salaried expense of the general office will affect this account.

50. INSURANCE.

This account includes the cost of all insurance carried, whether on the property of the railroad itself or property intrusted to it, as common carrier and warehouseman, or on persons, passengers, and employees for whose death or injury it may become liable. It is immaterial whether the insurance be carried by the railroad itself or an outside company, all regular expense in way of premiums is charged here.

Comment.—It is difficult to see what could be the intention of such an account. It is as if all lumber used on the road, whether ties, toothpicks, bridges, cars, flagstaffs, shingles, pianos, wagon spokes, dance pavilions, pencils, draughtsmen's tables, carpenters' hammers, or section men's shovels were regularly charged to the one expense account "lumber used."

Insurance is a method of paying an expense and not an expense itself, except for the amount of profit in the rate and any extravagance through insuring injudiciously. The amount of the expense is determined not so much by the rate as the amount of the

policies carried. One of the largest elements in the rate itself is the conditions of risk insured against, which are largely within the control of operation.

As a matter of fact, the amount of insurance carried is an exceedingly variable thing, resting entirely in the discretion of the management. If it is high it indicates little more than that the road has elected to pay through this account expenses that had otherwise gone through maintenance accounts and the contingency operating accounts, as "loss and damage," "injuries to persons." Nor may we justify this account on the ground that the fluctuations in the rate are even yet a sufficiently controlling factor to determine the amount of the expense largely, because the systems of fire protection and inspection, discipline, and superintendence, will greatly modify this. And these precautionary measures, and saving care, are altogether within the control of the management. So there only remains the profit in the rate, which is assumed to be so far the controlling factor in all expense for insurance, which is most responsible for the total amount of the insurance premiums paid, regardless of what purpose it serves, how conditioned, or how extensively it is the policy of the road to carry insurance.

From all these reasons it must be conceded that insurance is an expense of the maintenance of the specific property maintained and insurance against accident is a distinct expense of the particular work insured.

Examination.—From the nature of this account, no deductions are possible. If from other sources it is known that exactly a given amount of insurance of specified classes is carried we may judge of the rate, but it would be far more to the purpose to get the rate direct.

51. LAW EXPENSES.

This account embraces primarily such salaried legal service as is special to divisions or separable parts of the operation, under such titles as division counsel, assistant division counsel, solicitor, etc. It includes all the expense of their offices (except stationery), for salary of staff, for heat, light, rent, traveling expenses, law books, printing briefs, legal forms, testimony, etc. It next embraces the cost of irregular legal service paid as fees or retainers, also cost of arbitration to settle disputed questions (presumably only when advanced to point of legal contest). It includes all the incidental costs of legal procedure, as notarial, clerks', and special fees, and all costs of court and the fees and expenses of witnesses, except employees when serving as witnesses in loss and damage suits and except all witnesses in injuries to persons cases. Costs of court at time of receivership are included here, except that the receiver is considered an operating general officer and his fees are placed with the salaries of general officers.

Comment.—So much of this expense as is for a salaried staff, because it is a permanent establishment, for the service of all departments, is properly a general expense item. But such part as is composed of the irregular service of attorneys, irregular expense of all kind, such as costs of court, fees and expenses of witnesses, etc., is directly regulated by the volume of work that is done, and should be charged to that work. Where this work is general to the property the expense would remain in this general expense account. But where special, as for irregularities of operation, as injuries to persons, or damage to crops, by defective culvert, or burning of buildings by fire originating from spark of the locomotive, should be charged to that part of the work to which it was an incident, and where the amount of the damages assessed was charged. If

this principle is so far acknowledged as to include witnesses in case of injuries to persons, and the wages and expenses of employees serving as witnesses in case of loss and damage, we do not see why the classification should not have gone the full length and included the other court costs and all special legal fees, and traveling expenses of regular counsel.

The general nature of this expense is determined by the railroad's relation to enacted laws. It comes by natural transition to include any expenses incidental to laws not already enacted but proposed. Thus it will be the natural lodgment for the cost of a lobby and all those irregular expenses and blackmail that a railroad is exposed to.

Examination.—This account has no regular relation to the volume of business, but solely to the cases contested, which are often several years old. They may be due to the temper of the people even more than the negligence of operation. On some systems law agents who can handle whole States single-handed, in other States are kept busy with the territory of a single county. Respect for the rights of corporate property is a matter of education and in some communities is a matter of very slow process.

52. STATIONERY AND PRINTING (GENERAL OFFICES).

This account includes that part of the supplies of the general offices which comes under the general description of stationery, the other supplies being provided for in the account general office expenses and supplies. In addition to stationery for office use, it includes the printing of circulars, contracts, leases, bonds, stock certificates, and annual reports.

The distinction between those articles generally classed with stationery and those articles that are con-

sidered furniture is dwelt upon, under the head of "stationery and printing, maintenance of way."

It is doubtful if such expenses as printing annual reports, bonds, and stock certificates, which are the output of the office and not a part of its supplies, should not be classed with other expenses. But the distinction is hardly worth forcing. Altogether, this is the most satisfactory stationery and printing account in the whole classification.

Examination.—This is a very heavy item and will respond to the general conditions that affect the other general office accounts, but especially the plan of work of the accounting department. As an administrative expense it is much controlled by the methods of work, which may be constantly changing. It may affect the other stationery and printing accounts. By the extension of the use of blanks and duplicating, and adding, multiplying, and dividing devices it may affect clerical labor in a small way.

53. OTHER EXPENSES.

This, like the foregoing, is an administrative account, but differs in the fact that it includes only the irregular and unusual incidental expenses that cannot be located elsewhere. They are not such expenses as are incidental to any particular account, but have a general relation to all or else no relation to any of them all. Such would be notices of stockholders' meetings, financial notices in the papers, etc., irregular and nominal compensation to directors, etc.

This is a small and, from its nature, entirely irregular account, having no relation to the other accounts. It can only be examined by examining the individual items. The same account is very fully described where it occurs in maintenance of way.

PUBLIC STATISTICS.

1. The data required are primarily the information about individual railroads that shall be official. It is not intended as an elaborate guide to investors, but should be a reliable exhibit of the salient features of the road's condition and operation that may offer basis for judging of the solvency of the property, the characteristics of its business, and the general standard of its operations. If the road extends beyond the scope of the report, as in the case of the interstate road, in a State report, its operations should be shown entire unless they fall into smaller units that are distinctly independent. Such part of the properties and their operations as are actually confined to the State, and not artificial apportionments of interstate totals, should be shown in connection with the general figures, as memoranda. This data should be on official file, duly certified, and open to public inspection. Whether it is desirable to be at the expense of printing the detail for each road in the regular report is very doubtful.

The information that is needed is largely identical with that furnished by the annual reports of the railroads.

2. In discussing a railroad the first thing necessary is an accurate description of the physical property. Fixed property should appear in miles of first and second track and more tracks. Bridges and viaducts will appear in lineal feet by kinds of structure, whether wood, steel, or stone. Number of depots should appear under perhaps three arbitrary classes, according to their size and the facilities offered. The total number of grade crossings, number of miles ballasted, sin-

gle track, second track by kinds of ballast and depth ballasted, the miles of rail of different weight, in first and second track, the number of shops of first and second class, roundhouses, turntables, water stations, division and general offices, miles of telegraph line, miles of telegraph wire, miles of roadway protected by block signals, miles of road fenced, miles of tangent and of curve of each degree curvature, miles of gradients by ranges, miles of tunnel—are the principal items that are of any value as public information.

3. Further details, as number of ties per mile, telegraph poles per mile, roadway tool houses or hand-cars, elevation of track per degree of curvature, miles of rail of different templet, miles of different width of right of way—carry into the field of operating standards that can have no public interest. Local laws or methods of taxation may, however, call for special information to meet legal requirements. In connection with each item of this data any changes by addition or reduction during the year should be shown, and, where practicable, should be stated in the original units, their money value, and the percentage of change in each.

4. Rolling stock should be shown by classes, in case of cars, giving the engine number and aggregate ton capacity of each class. Engines and tenders should not be shown separately. The number of cars and engines fitted with air brakes, and cars with automatic couplers and roof guard rail, should be given. Certain large tools on wheels, as work cars, steam shovels, wreckers, and centrifugal snow plows should be added to the exhibit under their proper description. Changes during the year should be noted by number, value, and per cent.

5. Property, both fixed and movable, operated under lease, contract, or joint ownership, should be shown separately.

6. Following the description of the physical property will come a description of the ownership. This will differ in the priority of the claim on current and future income and of its ultimate claim on the actual physical property or on specified parts and in the title to voice in its management. Some of the distinctions may never become real because the conditions which give them effect may never arise. Until disintegration sets in, at time of foreclosure of any of the lines, they all bear equally on the general earning capacity of the property, whether they hold in pledge a whole or only a part of the property or simply are claimants of the income. The entire property, regardless of the various liens of different priority and extent, merges the proceeds of its operations into a general fund, from which each interest, to the extent of its claim, draws in the order of its right. All of its diverse parts are united into a financial unit because a common equity, vested in a single ownership, runs through them all and brings them all together in the general income account.

7. The three great statements by which we analyze the financial conditions and operations of a railroad are the general balance sheet, the income account, and the operating account. The last-named may be subdivided to detail operating accounts and each of these to still further detail. Each such account is a unit into which are gathered all the mutually supplementary causes to a given effect or group of effects, from which causes extending to other effects and effects depending on other causes are eliminated. The amount of such causes or the debit side of the account, therefore, is directly controlled by the amount of the effects or the credit side, and we may apply one to extinguish the other and only carry forward the net proceeds. This, whatever it may be, becomes in the next higher account one of the several contributory causes which

there unites with the other causes with which it is placed to produce a further result. Thus an originally obscure cause passes forward its effect to the general balance sheet. Theoretically the balance sheet is the funded amount of the income account. All the causes or costs that have been consumed in the results of a single year's operations are brought together with their results in the general income account, reduced to a net figure. This net figure is carried to the general balance sheet, being the amount of annual increment of fixed property or investment. For each dollar of investment, representing earning power, there are registered in the income account the corresponding annual earnings.

8. The general balance sheet is a statement of the fixed property at its money valuation and a distribution of the ownership. The properties here assembled are those whose title or whose equity, either entire or in part, is vested in the ownership that controls the road. Direct part ownership will appear at the proportionate part to which the road has claim. Mortgaged property, in which the full equity is vested in the road, should appear at its full value, offset by the liens against it. In cases where the road is only joint owner in the equity of a property, the full assets and liabilities of the property should appear in the general balance sheet. The equity, up to the amount owned, will be credited to stock and the remainder to account of the other joint owner. Generally such properties have securities of their own and they will enter on the balance sheet simply as securities of another property. For further information we are referred to the detail statement of that particular property.

9. Beginning with a property in which the road has all the equity we pass to only part of an equity of a whole property, which in turn may extend to very

insignificant proportions of a whole, and from part of a whole we may go to part of the equity of a part of property until we have been reduced to an equity which is little more than some advantageous privilege or permanent profit in use. Such, for instance, would be a joint monopoly in a single trade movement or a traffic agreement. Conditions of ownership, control, use for fixed rental, use for contingent rental with or without permanent liabilities, joint operation, and specific contracts, multiply to such diversity that we merge by imperceptible degrees from full ownership to what is no ownership at all. Some line must be drawn that shall rule off those properties from the balance sheet in which we have only a very insignificant equity, and it must necessarily be arbitrary.

10. In listing the company's property everything not pertaining to the business of the railroad transportation should be shown separately, such as coal mines, real estate, furnaces, coke ovens, etc. Next, detachable parts of the property that are accessory to the business of railroad transportation, but doubtfully belong to its immediate operations, as a belt line, toll bridge, picnic park, general tidewater terminals, elevator, general stock yards or warehouse facilities, or any considerable parts of the property that are financed separately, should appear separately. If the control is vested in the company by different kinds of equities, the list should be further itemized by the class of liens to which the various properties are liable. The quick assets will appear separately from the permanent investment and quick liabilities apart from those which are deferred by funding.

11. The income account includes those expenses and earnings that are special to one year and general for the whole year. Only such expenses as are paid on a fixed annual basis and have no relation to operation, but are permanent from year to year, as interest, rental

charges of entire properties on long lease, or taxes, should be itemized here. All expenses and earnings that, according to the conditions of operation, may be curtailed and abolished, or added and increased, would be itemized in the operating account, and only the net amount carried to this account. If it is a subordinate property that is separately financed, a separate income account should be had for it, from which the net results should be carried to the general income account.

12. The operating account is the receptacle for all those expenses and earnings that are special for periods less than a year, or are within the control of operation, so that a given expense tends to directly produce an earning and vice versa a given earning necessitates a given direct expense. Since the amount of the one largely controls the amount of the other, it is applied to wipe out the other as far as it will go, and only the net amount is carried forward to the income account.

13. If there are several kinds of operation there must be an operating account for each. The line may not always be easily determined between different kinds of operation. The types of what are the same business, rest on usage, because a service may consist of many parts, but only at one point does it levy on the public for return. This point may be entirely arbitrary, fixed by custom, but it becomes the basis on which the whole service is measured and classified. Perhaps no better instance can be cited than the passenger car mile, which has always been the basic notion in the making of passenger tariffs. Elegance, speed, comfort, safety, and luxurious terminal conveniences have been added, but the entire service is still in the original measure of miles hauled. The demand and supply of those passenger miles are conditioned by entirely different factors from the elements that determine the prosperity of coal business, toll bridge, or elevator operations.

14. But the lines of distinction are constantly chang-

ing. Where a railroad may have once conducted an added facility for its patrons on a paying basis as a separate though auxiliary enterprise, it may subsequently have to be content with *operating* it on a paying basis and bearing the fixed charges itself. Later it may be forced to give up all compensation for the extra outlay and extra service and fall back upon the hope of reimbursement in an increase in the regular business at the regular transportation tariff.

15. Practically there will be no difficulty in keeping distinct such clearly different kinds of operation as running a mill or mining property. Perhaps the charter restrictions may be such that their operations may never appear on the general books except as the net return from investments. But where the business is subsidiary and accessory to the strict business of transportation, the distinction may not be so obvious. As what may or may not be included in a standard service that is paid for at a given rate has come to be so largely a matter for legislatures to determine, it behooves the railroads to consolidate as few of such auxiliary operations into their regular operating accounts, as practicable.

16. After examining the road as a whole, we want to judge of the value of its securities in the light of what direct outlay they represent and what earnings they enjoy. They should be described as to the nature of the claim they hold on the general property, or part of the property, and show the amount authorized, amount issued, amount outstanding, consideration paid, nominal rate of interest, and actual rate of interest, and actual rate of interest and dividend paid in cash and in scrip.

17. As to the operation, enough information should be given to offer basis for judgment of the characteristics of the business, its density, regularity, and prospective permanence or increase. From this we may

know the general efficiency of operation and the relation of cost to expense.

18. The freight service unit is the ton mile and the passenger service unit is the passenger mile. The elements of speed, safety, relative risk, density, and terminal service, throughout the diversity of traffic conditions, together with miles hauled, variously enter to determine the cost, while value of service enters to determine the price. These elements cannot be specifically measured, vital as they are, except by classifying our service units according to the degree in which they severally prevail. Ton miles should be shown by commodities, competitive and non-competitive, and again by territorial groupings of movements. Against each of these, in all their various developments, should be placed the revenue. Passenger miles should be divided into classes of local, through, commuter, tourist, special, and deadhead, with the revenue, number of passengers, and average haul. To indicate the density, the ton miles per mile of road, and passenger miles per mile of road and per passenger car should be given. Car miles should appear by kind of car, and in case of freight cars by loaded and empty. Engine miles should be shown by passenger, freight, switch, helper, and work. Train miles should be shown by passenger, freight, and special. The direct freight train and the direct passenger train costs should be shown, and against these the respective train mileage. Engine costs for repairs, wages, coal, and other supplies should be placed against the engine miles, by kinds of service, and the car repairs against the car miles by kinds of cars. The general paying character of the business, into which the factor of density would be incorporated, would be the freight and passenger earnings respectively per mile of roadway.

19. To judge of the economy of expenditure, the expense account should be stated in detail. The In-

terstate Commerce Classification, which is that generally in use, is discussed at another place.

20. Since the railroads furnish the largest single industry outside of agriculture, no public report can ignore the sociological side of their operations. The number of employees, their age, education, conjugal condition, nationality, length of railroad service, length in present service, hours, rate of earnings, actual earnings, days employed during the year, accidents, etc., carry to questions of large public interest. The classification adopted should show at least two grades of skilled labor, clerical labor, two grades of superintendence, common labor, and large special classes, as enginemen, conductors, and other trainmen. If the railroad enters largely into the manufacture of any of its supplies, the incidental labor should be exhibited separately.

21. The nature of the service offered to the public and the extent to which it is used by the public should be indicated by miles of road, which are served with single daily way train service, double daily way train service, number of points having single, double, daily, and more express train service, average speed of way train service, express trains, through freight trains, and the passenger earnings per train. The number of passengers per train mile, car mile, sleeping, chair, and parlor car, express train car, way train car, would show the extent to which each kind of service was used. The ratio of baggage car miles to passenger car miles would indicate baggage service furnished. The kind of service offered must be further measured by statistics of accidents to passengers of express and way trains classified, as due to negligence of operating, if by fault of the dispatcher or failure of signals, operator, flagman, engineman, conductor, or defect of material, if fault of rolling stock or roadbed, or lawlessness, if due to malicious train wrecking.

22. The real purpose of a public report is to make a general exhibit of railroad operations as a whole in the territory under review. It should bring into outline the relations sustained to the public in the extent and efficiency of the service performed and the industrial, commercial, and sociological effects produced. For this purpose the data must be tabulated. These tabulations with the explanatory text are the matter in which the public is vitally interested.

23. Often there are salient features that throw the roads into natural groupings. Where these occur they should not be ignored in the compilation of the tables. For instance, there are interstate, intrastate, and State lines; there are coal roads, crop roads, and commercial roads; there are branch lines and trunk lines; there are roads where the normal density of traffic is high and there are those where it is low. In this discrimination lies the nicety of the statistical work. But the groupings should always be natural, never forced by artificially prorating undistributable figures. It is not necessary that one arrangement be rigidly adhered to in all the tables. On the contrary, the grouping had may be largely special to each table according to the particular information to be brought out.

24. Almost all the information for public use that is desirable in detail, from each railroad, should be set forth in tables. These tables will bring into profile the facts having public significance, and are necessary to make these facts available for general use.

25. Tabulation of the data descriptive of the fixed property will describe the physical conditions under which railroad operation is conducted in the State or section under review. Some of these, as grades, curves, tunnels, and bridges, are due to natural conditions peculiar to the topography of their territory. If part of it is mountainous, part plain and prairie, this

distinction should be set up in the tabulation. Other conditions, as weight of rail, miles of ballast, block signaling, depots of different grade, will depend on the standard maintained, which in turn depends largely on the density of business. The distinction here suggested at once is trunk line, auxiliary line, and special line, as coal, lumber, ore lines, which would determine the kind of tabulation followed. In the same way the rolling stock will be variously classified according to natural and commercial conditions prevailing. An important economic factor in describing the transportation service and capacity of that service, offered a given territory, is the total dead weight in tons, of the equipment, and the total net capacity in tons.

26. The financial conditions of the railroads in a given territory will respond to the conditions of the trade in which the principal traffic lies. Crop failures, drouths, depression in iron industry, cotton manufacture or lumber business, or miners' strikes, will be variously identified with the different territories served by different railroads. They may be sufficiently controlling causes to come into the tabulation of the income accounts. A very important inquiry is into the relation of auxiliary operations that are closely identified with transportation and may or may not be finally done by the railroad. They may be supported with a charge in which there shall be a profit, with a charge that simply keeps the railroad whole for the full investment, with a charge that only covers direct operating expenses, with no extra charge at all. Such would be warehouses, belt companies, general stock yards, cotton compresses, etc. Wherever these have a detail income account or separate operating account they should be carefully tabulated, to show the results of their operations.

27. The securities should be tabulated by rate of interest or dividend they pay, their value stated at par,

and also where practicable, at actual cost. Defaults and foreclosures should be stated in their aggregate. The immediate, solvent condition of the railroads should be stated in a consolidation balance sheet of all the roads involved, roughly tabulated according to the proportion of their operations confined to the territory covered by the public report.

28. The data as to operation will, like the great body of information, be tabulated according to the traffic and operating conditions that prevail. Train costs in the mountains should be higher than in the plain, and the density of movement of all kinds will vary according to commercial conditions. The detail of expenses, however, should not be subjected to too fine a classification. There is no special distinction between the service of employees of different railroads. No classification in that respect is really useful in the tabulation of the data about employees, except perhaps to distinguish between railroads generally and special lines in coal, lumber, ore districts, etc. However, should the scope of the survey be so general as to include radically different conditions of labor, as to race, literacy, and prevailing wages scale, such conditions should not be ignored in tabulation. But the facts about employees are of importance and are very suggestive in various combinations among themselves. The amount and per cent. of the gross disbursements accruing to labor, compared with that for material, interest, and dividend, are facts of wide interest.

29. The relation of the railroads as a whole, to the industries and commerce of the section covered by the report, is never more than touched upon in public reports. Yet there could hardly be a department of inquiry touching things of more vital significance to the community served. To begin with the physical features of the railroad system, figures should be given to show the accessibility and general distribution of rail-

road mileage with reference to population, and area and assessed land values. Tabulate the population within five, ten, fifteen, and more miles from a railroad. Do the same with area and assessed land values.

30. There are no better means to analyze trade movements than statistics that railroads can furnish. It has been for a long time customary to consider railroad tonnage a rough index to the condition of trade. It is entirely feasible to go further and analyze the general total into information that shall have some significance and practical value. Commodity movements should be roughly analyzed as to geographical distribution, the average, the maximum, and minimum rate, during the period reported on leading commodities, to leading markets, or tidewater or general gateways, and its relation to the market price.

31. The railways as an industry in a State will be indicated by the amount of revenue collected and expenses disbursed within the State. The relation of the railways to a particular State can be rudely apportioned by the assignment of their distributable expenses and earnings to State, interstate, and intrastate business. An item of no small consequence to the industries of some sections, is the amount of value applied to crude material in transit and the consequent employment for labor and capital by the concession of "milling in transit." There is also the relation of the commodity movements to seasons, special market fluctuations, and bank clearances, which under special conditions might be of value. But for the most part these are only items of curious interest.

32. In the economic survey of the transportation conditions as a whole, in a given territory, one of the great factors of expense that ultimately must enter into the price at which the service is performed, is waste by duplication and excessive and useless concessions irregularly given. These, under the conditions of

trade, are to the individual road circumstances to which it must conform as absolutely as to the topography of the country through which it operates. The ultimate effects have no part in the practical conduct of a railroad, except so far as the question of their persistence comes in. But in a larger public view, alternative conditions may be discussed, and it becomes essential to know the amount and tendency of such expense by waste. For freight it may be located in (*a*) the terminal service, as station service, local switching, car detention and extraordinary facilities of warehouse, compress, stock yard, elevator, etc., reduced to their money value and placed against the tons handled. (*b*) Excessive hauls had by deducting from actual ton miles the short line ton miles. (*c*) Excessive passenger service stated in equivalent coach miles computed from unused capacity of coach miles actually run. These are the direct, tangible outlays. There is, in addition, the cost not directly connected with physical service, such as advertising and soliciting.

OPERATING UNITS.

THE CAR MILE.

1. The car mile is the travel of a car one mile. It is taken as the unit of car movement in all the relations sustained to cost and service rendered. In Germany it gives place to the axle mile; but cars in this country, save in some mining territories where the obsolete "jimmies" still persist, are of the double four-wheel swing bogie truck type, and the necessity for the axle miles does not exist. As related to cost, the car-mile unit is modified by speed, grades, alignment, actual load, cars per train, gross weight, character of the car as affecting maintenance, and hours of moving to hours idle. Sometimes some of these factors are eliminated. Thus empty cars are reduced to a loaded car basis. Again the effects on train resistance and consequently on cost, due to alignment, grades, and various speeds, are consolidated into a constructive performance unit.

2. On the side of service the car mile as a unit is modified by the kind of commodity it is adapted to carry, the tonnage capacity, direction with reference to prevailing traffic.

3. For examination of actual car movement we want simply the loaded and empty car mile, developed successively by the different factors examined.

4. The caboose miles has been the source of much contention. The American Association of Railway Accountants undertook to settle the uncertainty by the ruling:

"When the 'mileage of loaded freight cars' and the

'mileage of empty freight cars' are both shown in reports, the mileage of caboose cars should be included in the 'mileage of empty freight cars.'"

But this is open to criticism. A caboose is a different thing from a freight car. It is lighter, often has less journals, and stands in different relation to the body of costs and of service. While it is a definite added cost to the train, it is, except in rare instances, an inseparable feature of train movement, as much as the tender on the locomotive. It is invariably present, as an essential element in all car movement. Therefore, if its repairs and other costs are borne by the freight car mileage, for purposes of car performance it is a practically constant element in all comparisons. There is no need for separating it. The only purpose in such separation would be to note any irregularities of cost, special to it alone. Such would be excessive repairs or excess of caboose equipment over needs. But this is hardly sufficient to justify a regular entry in a current performance sheet.

5. As shown, the car mile is subject to a great variety of modifying conditions, which greatly limit its usefulness. Except for a few items of information it would be better if the car be abolished as a basis for making a unit. The standard type of car on some roads has changed so very rapidly that the car of one period has practically nothing in common with the car of another period, save the name. As a substitute for the car mile and car day we should use the gross ton mile and the net ton mile, making a distinction between loaded and empty cars. The president of a certain road, which had replaced its six-ton cars with fifty-ton cars, was greatly disturbed when the car movement of a particular day compared unfavorably with the year previous in number of cars moved. The situation, which by his superficial analysis was bad, in reality was many times better than the year previous.

Particularly desirable are the ton miles as a basis, instead of the car mile, since they once and for all time abolish the "loaded" car mile whose significance is so relative a thing.

THE TON MILE.

6. The ton mile is one ton of freight moved one mile. It is taken as the ultimate unit of freight service and approximate unit of freight transportation expense. To make the average ton mile of the road, all lengths of haul, all varieties of service, and all kinds of freight are thrown together indiscriminately.

7. On the side of cost, freight transportation is composed of train operation for the linear mile, modified by grades and alignments, insurance, ratio of bulk to weight of article, conditions of transportation, direction of movement with reference to prevailing traffic, and per cent. of prevalence in one direction, terminal service and unused capacity of track for train movement. Except the terminal handling and so much of the maintenance and general charges as are represented by the unused capacity of the track, all of these items are a direct expense to the ton mile for a given commodity. Therefore, after their individual variations, their expense will vary directly as the ton miles made.

8. The terminal handling is a fixed expense to the ton and not the ton mile. According to the law of increasing return it will apply as a decreasing expense to the ton mile with each added mile of haul. The maintenance and general charges are a fixed expense to all business handled. By the law of increasing return they will be borne at a less rate per unit of service, with the increasing volume of all business. Only so long as the volume of business remains about the same can we estimate what proportion of the whole fixed expense falls to the average ton mile. And only

when the average length of haul represents the general haul, and is not a theoretical mean between wide extremes, may we say what is the terminal expense per ton mile. The terminal expense per ton mile is anywhere from five per cent. to forty per cent. of the direct cost of moving a ton of freight one mile, according to the length of the haul. For merchandise or parcel freight costing seven cents per ton station labor of handling, which is not excessive, with a haul of fifty miles, the terminal cost is forty per cent. of the entire direct expense.

9. Thus, through changes in the proportion of different classes of freight handled, as they affect the length of haul, without change in the aggregate volume and with no change in the rate of costs for each of the items entering into the total expense, there may be very considerable changes in the general average cost per ton mile. And if this be so, when radical changes occur in the character of the business, the general average ton mile may convey no information. Indeed, it may be very misleading. For any intelligent information the ton miles should be successively exhibited by the different factors that cost. Thus it should be shown by ranges of density per ton mile, by commodities, and again by length of haul. Only in this way can be formed accurate judgment of the real work as it affects expense.

10. The ton mile as a unit of service has a different value for each use served. Thus a ton mile of paving blocks is not of equal use with a ton mile of milk, of dressed beef, or canned fruit. And, again, a ton mile of wheat at a remote distance from the market is not of equal use with a ton mile of wheat in close proximity to the market, because each ton mile in the first case counts for less in bringing a given quantity to supply a given use than it does in the second case.

11. The identity of a service is described first by a

given number of physical units for the same use. The "same use" is generally taken to be use for the same article of consumption. But it came in time to be the use for the article that is its substitute. Then again it may not be use of the article for consumption, but use of the article as a crude material in manufacture of a product for a distant market, of which an extreme example would be "milling in transit."

Fifty ton miles in one service is thought to be equivalent to one hundred ton miles in a service that is only one-half the use. But unless one use supplants the other, an extension of service on the one does not make good the lack of it in the other. Therefore, unless one article or use of transportation is served at the direct cost of another, or unless it definitely supplants another, or unless its greater volume, while not directly superseding the first article, does disturb the demand for it by cultivating an extended and hitherto undeveloped demand for the second article or use, a variation of the different uses served will invalidate the average of all for purposes of comparison.

12. And when none of the foregoing conditions are present a reduced average cost per ton mile, brought about by greater proportional volume of low grade business, cannot be called a decline in rates, so far as related to the value of the service performed.

THE PASSENGER MILE.

13. The passenger mile, which is the movement of one passenger one mile, is taken as the unit of cost and of service in passenger transportation.

However, as a unit of cost, it has many limitations. The actual cost of transportation of any one passenger is hardly more than the cost of printing the ticket on which he travels and the insurance against personal injury. The depot must be provided, the

ticket seller must be on duty, the train must make the run and stop and start at the stations where he gets on and off, whether this one passenger more or less travels or not. And his transportation costs appreciably no more for one hundred miles than for fifty. As a unit of cost for the general body of the passenger business it is inaccurate, because factors of speed, grades, dead weight, terminal convenience, etc., are not included. In the larger area of maintenance and fixed charges, it cannot serve as a unit, because the variation due to the traffic density is ignored. If these factors had any uniformity they might be left out without invalidating the unit for purposes of comparison, but as between different roads or different periods in railroad operation the speed may vary from twenty to sixty-five miles an hour, the maximum grade from ½ per cent. to 4½ per cent., the dead weight per passenger from one-half to five tons, the traffic density per train from twenty-five to one hundred passengers, the train movement from two to seventy trains per day, the station convenience from mere platform and sheds to great depots with every appointment of luxury and convenience.

14. The passenger mile is more peculiarly a unit of service. But it is each year becoming progressively less so, as distance is a less factor in limiting movement. In the first place the desirability of going to a certain place was set against the cost of getting there, which was directly as miles to be traveled, whether the journey was afoot, by horse, or by stage. Thus the need and use of actual journeys came to be proximately proportional to distance. But this is no longer so. Travel that was first for pleasure or personal reasons has come to be many times multiplied by the travel for business. The value of such travel rests on strictly industrial and commercial conditions. To the theatrical manager, the showman, or the commercial house

it is as impersonal an item of operating expenses as any other regularly calculated expense. Such travel serves different commercial and industrial uses and may have different value to the consumer, which may have no reference to exact miles.

THE TRAIN MILE.

15. The train mile is taken as the unit of movement between terminals. It is assumed that the thing we call a train affects coal consumption, oil and waste consumption, engine repairs, car repairs, train service, and engineers' and firemen's wages, and produces service approximately, as miles run.

16. In moving cars in a train some costs are special to each car, as oil and waste cars, and repairs; others are in part general expense to the train movement, and in part a direct expense to each car. Such would be engine fuel, of which thirty per cent. to fifty per cent. has no relation to the number of cars in the train. Others still, as engineers' and firemen's wages, have no relation whatever to the number of cars. On the side of service all the performance is special to each car and there is no performance that is special for the train. But in case of both the costs and the services, that are special for each car, there is assumed to be an average number of cars per train and an average cost and service of all cars. Hence the train mile, by this reasoning, has come to be the general unit of line-of-road movement, as it affects costs and produces service. But we believe the train mile as a unit has long ceased to be of any value, except for the most limited comparisons.

17. The type of the thing we call a *train,* varies greatly. We may have one or two or three engines, or the second engine only for a short distance. In deciding whether we shall consider these variations as one

train or two or three trains, we must keep in mind that the train mile is intended and is used as a rough unit of cost and of service. In case of the double header, if we count this as two trains, plainly we have greatly reduced the cost per train mile by the greater usefulness of the train-service costs. But our coal, oil, and enginemen's wages costs will remain the same in their relations to car miles. Also our number of cars per engine will be about the same. It is, therefore, perfectly proper to consider it two trains because such saving as has been effected is entirely within the discretion of the officer making it. The expense is not increased proportionally at some other place, unless possibly we have overstrained our draft rigging, exposing the movement to breakdowns and consequent delays.

18. But when an engine acts only as a helper and serves only one way, running back light, the question takes a new form. Plainly the effective mileage it makes is only that when it is under load. This effective mileage must bear the full cost of the light miles, yet the light miles cost as much for enginemen's wages as the loaded miles, and contribute directly to increase the oil and coal consumption and repairs. Therefore we should consider the engine mile when under load, a train mile. We place against the loaded mileage the full costs, and carry separately, and only for memorandum purposes, the light mileage. If the repairs and oil for the light mileage, added to the same for the loaded mileage, are abnormally high, they must be offset by the loaded mileage costs saved. These are the costs which the engine would have incurred if it had completed the entire run instead of serving as mere helper. If now the balance is against the practice of using a helper engine, the fact should appear in increasing the cost of operation under these conditions, and the practice would be abolished.

19. Some officers prefer that the double-header should be considered as one train, so that their car mileage per train may "show high." They are abnormally swelling their costs per train in enginemen's wages and supplies and are really covering up and losing sight of the performance of their engines because two engines should normally pull about twice as much as one. Should our second engine be a mere helper engine, to lift trains over a hill, it would not be proper to consider it a double-header at all. This would be true of two or three helping points. But if the helping engine goes over a considerable stretch to include down grades as well as up grades it should be considered a road engine.

However, these devices are only partly satisfactory in bolstering up the very lame unit of the train mile.

20. The train mile, unfortunately, has come to be a very important factor in all exhibits of railroad operation. Its defects are not generally understood and, where understood, are only tacitly acknowledged. It introduces such latitude for uncertainty into railroad reports that it is to be regretted that the American Association of Railway Accountants have dignified it by a very full definition and explanation in the report of their committee upon train and locomotive mileage. The deliveries of this association are very properly accorded great weight. Those that bear on the exhibit of railway operations are generally, in the course of time, taken up by the statistician of the Interstate Commerce Commission and embodied in the official classification. For this reason, and owing to the importance of the subject, we give below, in full, the report referred to above.

REPORT OF SPECIAL COMMITTEE ON TRAIN AND LOCOMOTIVE MILEAGE.

Train Mileage.

For the purpose of preparing the statistical figures usually given in the annual reports submitted by railway companies to their stockholders, and those called for by the Interstate Commerce Commission and the several State railway commissions, it is suggested that train mileage be divided into two general classes, revenue train mileage and non-revenue train mileage, and that revenue train mileage be subdivided into passenger train mileage, freight train mileage, and mixed train mileage.

There is no objection to this classification being extended as may best suit the preference of individual roads, but the above are the only classes that are required for the purposes mentioned.

Passenger train mileage embraces the mileage of trains run to transport revenue earning passengers, and to carry baggage, mail, express matter, milk, and other articles earning revenue, which is classed as passenger earnings; provided such trains do not regularly include a car or cars devoted exclusively or principally to revenue freight business.

Freight train mileage embraces the mileage of trains run to transport revenue earning freight, and which do not regularly include a car or cars devoted exclusively or principally to revenue passenger business. Also, the mileage of trains consisting of empty cars and of trains consisting of a locomotive and a caboose, running light between terminal stations, on account of the greater tonnage being in one direction.

When one or more milk cars are hauled in a passenger train, the mileage of that train should be considered passenger train mileage. When milk cars or

express cars are hauled in a through or fast freight train, and their earnings are classed as freight earnings, the mileage of the train should be considered as freight train mileage.

Mixed train mileage embraces the mileage of trains run to transport both passengers and freight earning revenue in cars, each of which is devoted exclusively to either passenger business or freight business. Freight trains that haul no passenger-service equipment, but transport passengers in a caboose, are not mixed trains, and their mileage should be treated as freight train mileage.

Non-revenue train mileage embraces the mileage of all trains not directly connected with the earnings of revenue, such as:

(*a*) Trains of the passenger class, *i. e.*, pay trains, official trains, complimentary special trains, and trains run to convey employees to and from shops.

(*b*) Trains of the freight class, *i. e.*, material and supply trains.

(*c*) Trains of the work class, *i. e.*, gravel trains, ballast trains, construction trains, wrecking trains, repair trains, snow plows, and flangers. Only the total mileage of non-revenue trains is called for, not the mileage under three sub-classes.

Rules for Computation.

1. Revenue train mileage should be based on the actual distance run between terminals and computed from the official time-table or distance table, the same as for passenger mileage, ton mileage, and car mileage.

2. Revenue passenger trains and revenue mixed trains may incidentally carry private cars, official cars, work or service cars, or cars of other classes; and revenue freight trains may incidentally carry cars containing railway material and supplies, or other freight

which does not earn revenue; but whole trains of such cars should be regarded as non-revenue trains and classed accordingly.

3. The mileage of non-revenue trains should be based on the actual distance run between terminals. When work trains are run between terminals and not ordered to work at some specified point or within specified working limits, they should be allowed the actual mileage made, the same as any other class of trains. When ordered to run to a certain point to work at that point or within specified working limits, they should be allowed the actual mileage made while under running orders and in addition an arbitrary mileage of six miles per hour for the time working at the point or within the working limits named.

4. Each train and each section of a train run by a separate train crew should be considered a separate train, whether hauled by one or more locomotives for either the whole distance or a part of the distance between the train terminals. There should be nothing added to this distance to cover running from roundhouse to terminal, doubling hills, running for water, switching, or other work at way stations, or for the service of helper or pusher engines, or the extra engines on double or triple head trains.

5. The use of the term "switching train mileage" should be abandoned, such mileage being more properly called "switching locomotive mileage."

To ascertain the "average number of passenger cars hauled per train" and the "average number of passengers per train," the "mileage of passenger cars" and the "number of passengers carried one mile" should respectively be divided by the sum of the "mileage of revenue passenger trains" and "mileage of revenue mixed trains."

To ascertain the "average number of freight cars

hauled per train" and the "average number of tons hauled per train," the "mileage of freight cars" and the "number of tons hauled one mile" should respectively be divided by the sum of the "mileage of revenue mixed trains" and "mileage of revenue freight trains."

21. Commenting on the foregoing under head of Rules for Computation as there laid down, the train is defined. This, as noted above, we believe open to serious criticism. In paragraph No. 4 the definition that "each train and each section of a train run by a separate train crew should be considered a separate train, whether hauled by one or more locomotives, for either the whole distance or part of the distance between terminals" is radically wrong. The train service items of flagman and conductor are the only items that are a fixed cost of train, which must vary directly with the number of train-mile miles made. They consist of less than twenty per cent. of the whole cost of operating that train. To classify things by factors that have only a significance of twenty per cent., and ignore the factor that has a significance amounting to eighty per cent. of the whole body of determining causes, is a violation of all principles of classification. The engine is more nearly the index to the cost and service, and so the proper unit of cost and service of what is called a train. Engineers' and firemen's wages, locomotive repairs, the estimated one-third or more of the fuel that is directly consumed for the movement of the engine itself, vary directly with the number of engine miles. The oil and waste cars, the car repairs, the irregular number of brakemen and the remainder or two-thirds of the engine fuel of the engine, vary directly with the size of the train, which is roughly dependent upon the motive power assigned to that train. The defects of the train miles

the committee have sought to overcome by showing helping mileage separately and showing the ratio of helping mileage to the whole mileage made. But it is very questionable if this at all meets the difficulty.

22. The committee use the mixed train mileage once with the passenger train mileage to arrive at the number of passengers per car and passengers per train, and again with the freight mileage they use the same mixed mileage to find the average number of cars per freight train and tons per freight train. Thus, assuming that the passenger train mile were approximately equal to the freight train mile, we are increasing all mixed train mileage by one hundred per cent., and *per contra* dividing the good showing of our train performance by two, just so far as mixed trains entered into our computation. Fortunately the inherent fallacy of this is not of great importance, because generally the mixed train mileage is very insignificant. It is a very poor makeshift, to avoid the fallacy of the general practice of considering mixed trains as one-fourth passenger and three-fourths freight. Assuming that there were equal urgency for both kinds of service, so that frequency of running did not come in to make the cost special for the one which had not otherwise been incurred, then the cost for each should be apportioned on the basis of some unit of service common to both. This unit obviously would be weight hauled so far as the engine and train costs were concerned. If the passenger service required a baggageman or special rate of pay to conductor or unusual speed or backing or shifting of train to place the coach at the depot, then such direct expense should be first deducted from the total cost of the train and charged direct to the service benefited.

ENGINE MILE.

23. The engine mile serves as the work unit. A locomotive is taken as a unit in motive power. It is not a substitute for the exact unit of energy which is the tractive unit, but a rude measure in defining the relations of motive power to cost and to service rendered. The locomotive weighs thirty to one hundred tons; it may be rated at fifteen to ninety loads; its fuel consumption may be normally 4 to 9 cents a mile; its repairs, 3½ to 8 cents; it may be designed for speed or for draft, may be simple or compounded, have four or six or eight driving wheels. It may be used for express or accommodation service, for switching, helper, or work train service. An engine mile is made when any one of these engines, big or little, fast or slow, loaded or light, rolls over a mile of rail.

24. The uncertainty of a unit that is so obviously irregular in those relations which it is designed to measure makes it necessary to divide the mileage according to services, which block it rudely into classes of average speed and load and general working conditions. Comparisons within each service show the performance of the locomotives in that service. But between services or regardless of service the comparisons are misleading.

25. The American Association of Railway Accountants have very elaborately defined and classified locomotive mileage, and their report is given below.

Locomotive Mileage.

The use of locomotive mileage is principally confined to what is known as "performance sheets." These reports vary, and because locomotives are often used in more than one class of work, many perform-

ance sheets do not undertake to show figures for each kind of locomotive or for each class of work, except in a limited way.

In order that all performance sheets may be made upon a uniform basis, it is suggested that locomotive mileage be classified as follows:

Passenger locomotive mileage,
Freight locomotive mileage,
Mixed train locomotive mileage,
Helping locomotive mileage,
Light locomotive mileage,
Switching locomotive mileage,
Work locomotive mileage.

There is no objection to this classification being extended to suit the preference of individual accounting officers, so long as the classification adopted can be combined to produce the classes above named.

Passenger locomotive mileage embraces:

(*a*) Revenue passenger train mileage.

(*b*) Non-revenue passenger train mileage; being the mileage of non-revenue trains of the passenger class, such as pay trains, official trains, complimentary special trains, trains run to convey employees to and from shops, etc.

Freight locomotive mileage embraces:

(*a*) Revenue freight train mileage.

(*b*) Non-revenue freight train mileage; being mileage of non-revenue trains of the freight class, such as material and supply trains.

Mixed train mileage embraces:

Revenue mixed train mileage.

Helping locomotive mileage embraces the mileage made by locomotives while pushing, double-heading, or in any similar way assisting passenger trains, freight trains, mixed trains, or non-revenue trains; also the additional loaded mileage made in doubling hills.

Light locomotive mileage embraces the mileage

made by locomotives running light, as when running for water or fuel, running to or from roundhouses, shops, or trains; running light after pushing, double-heading, or in any similar way assisting passenger, freight, mixed, or non-revenue trains, and light mileage made in doubling hills; also the mileage made by locomotives when running with only a caboose attached.

Switching locomotive mileage embraces all loaded or light mileage made in switching, except shop or work switching.

Work locomotive mileage embraces the mileage of all trains of the work class, such as gravel trains, ballast trains, construction trains, wrecking trains, repair trains, snow plows, and flangers, and the mileage of locomotives employed in shop switching.

If for the purpose of comparison with figures of former years, or for any other purpose, it is desired by any railroad to combine the different classes of locomotive mileage into the four general heads,—passenger, freight, switching, and work,—it is suggested that the combination be made as follows:

1. Passenger locomotive mileage.
2. A proportion of mixed trains locomotive mileage, based on the work performed.
3. The mileage made by locomotives helping passenger trains.
4. The light mileage made by locomotives while in passenger service.

Freight mileage to include:

1. Freight locomotive mileage.
2. A proportion of mixed train locomotive mileage based on the work performed.
3. The mileage of locomotives engaged in helping freight trains.
4. The light mileage made by locomotives while in freight service.

Switching and work mileage should be as previously given.

Rules for Computation.

1. All locomotive mileage made in hauling trains, except helping mileage and work-train mileage, should be based on the actual distance run between terminals, to be computed from the official time-table or distance table as prescribed for train mileage.

2. Helping mileage of locomotives should be based on the actual distance made with trains in helping service or in doubling hills.

3. Work-train mileage of locomotives should be arrived at as prescribed for work-train mileage.

4. Light mileage of locomotives should be based on the actual distance locomotives are run light, or with only a caboose for the entire distance between terminals.

5. Mileage of locomotives switching in yards and at terminals should be computed upon a constructive mileage of six miles per hour. Switching or other work at way stations not having switching locomotives should not be allowed for, except to locomotives of local or way freight trains, which, when employed for switching for one hour or over at any station, should be allowed a constructive switching mileage of six miles per hour for the actual time employed in switching. No allowance should be made when the time employed in switching is less than one hour at any one station.

Manner of Showing Mileage Figures in Reports and Their Use in Preparation of Statistics.

It is respectfully suggested that in all reports mileage figures be shown in the following manner:

TRAIN MILEAGE.

Mileage of Revenue Passenger Trains,		.....
Mileage of Locomotives employed in "Helping" Passenger Trains,	.....	
Percentage of "Helping" to Revenue Train Mileage,	.....	
Mileage of Revenue Mixed Trains,		.....
Mileage of Revenue Freight Trains,		.....
Mileage of Locomotives employed in "Helping" Mixed and Freight Trains,	.....	
Percentage of "Helping" to Revenue Train Mileage,	.....	
Total Revenue Train Mileage,		.....
Mileage of Non-Revenue Trains,		.....

26. Looking over this report as above, it would seem that the engine mile, even when divided according to service, is unnecessarily indefinite. This is especially true when used to measure the very large costs that are within the direct regulation of the management. As well note the mileage of fly wheels spinning round in the air, at the shops or other places where the road generates power by stationary engines. It is true that there is a certain fixed cost to the engine mile, without load and regardless of speed. This may be thirty to fifty per cent. of its ordinary fuel consumption, perhaps more of its repairs, and one hundred per cent. of its engineers' and firemen's cost. To this extent only is the engine mile a unit, in cost of power, and then only when the engines are of the same general class. It has already been largely superseded in railway practice, as a unit of the effective power itself. It is better to consider the locomotive a machine of various capacity, used for work. The amount of this work, rather than the number of engines employed in doing it, affects costs and determines the amount of service.

27. The effort to place switch engines and work-train engines on the same basis with road engines by assigning to them a constructive mileage is open to

criticism. The thought generally in fixing upon a mileage rate per hour is that it is an approximate estimate of the number of linear miles of rail which the engine actually rolled over in that time. This idea is wholly erroneous. The real object in giving switch and work-train engines a constructive mileage is to offer a basis by which we can reduce the normal expense of the switch or work-engine hour, to the equivalent of road miles which the same cost normally would produce if the engine were in road service.

28. Since the committee have taken the train mile as a basis, instead of the locomotive mile or better unit, they have made the locomotive mile a memorandum figure, to explain the train mile. The thought is that by stating the relative amount of helping mileage to the whole road mileage, by each service, the inaccuracy of the train mile can be roughly corrected in looking over the exhibit of operations.

29. The theoretical unit of engine efficiency is the "tractive unit," which is the theoretical draw-bar pull. The effectiveness of this unit is of course greatly modified by the conditions which the engine is called upon to meet. But ultimately in the canvass of a great aggregate of power for a road this is the unit in which we describe best the amount of power in service. The engine mile, equally with the car mile, is a relic and should be abolished except for a limited use, in statistics. The tractive unit commuted by the factor of rolling friction, to its equivalent in tons hauled on a straight and level track when the factor of distance has been added, becomes a unit of work.

On the Mexican International Railway it has been found practicable to use a performance unit as an index to performance and expense of engines in service. This unit is designed to take up the variations in grade, alignment, and speed as they affect cost. By courtesy of Mr. F. W. Johnstone, superintendent of motive

power, is given below the explanation and formulæ for the unit which he has devised and put into use.

Mr. F. W. Johnstone's Locomotive Performance Unit.

30. Method of reducing grades and curves to an equivalent straight and level track, and of determining the units of work performed by locomotives in hauling trains over a given section of road:

Let one hundred gross tons hauled one mile over a straight and level track (at so low a rate of speed that the resistance due to speed will be considered 0) be taken as a unit of work performed, and as the resistance per gross ton hauled upon a straight and level track at a very low rate of speed is six pounds, the resistance per gross ton on any grade and at a given speed in miles per hour should be divided by six, and the result must be multiplied into the length of the grade, to ascertain the equivalent length of level track. If curves are not compensated, one-half pound per degree of curvature should be added to resistance due to grade speed and rolling friction before dividing by six.

It is evident that for different speeds per hour the total resistance will vary; therefore it is necessary to figure out these distances separately for trains running on different schedules of speed.

TABLE NO. 1.

TOTAL RESISTANCE PER GROSS TON OF TRAINS RUNNING FIFTEEN MILES PER HOUR, OVER VARIOUS GRADES (CURVES COMPENSATED.)

0.0	per cent.	7.41	1.0	per cent.	26.91	2.0	per cent.	46.41
0.1	"	9.36	1.1	"	28.86	2.1	"	48.36
0.2	"	11.31	1.2	"	30.81	2.2	"	50.31
0.3	"	13.26	1.3	"	32.76	2.3	"	52.26
0.4	"	15.21	1.4	"	34.71	2.4	"	54.21
0.5	"	17.16	1.5	"	36.—	2.5	"	56.16
0.6	"	19.11	1.6	"	38.61	2.6	"	58.11
0.7	"	21.06	1.7	"	40.56	2.7	"	60.06
0.8	"	23.01	1.8	"	42.51	2.8	"	62.01
0.9	"	24.96	1.9	"	44.46	2.9	"	63.96
						3.0	"	65.91

For example: Table No. 1 shows the total resistance per gross ton on various grades (curves compensated) of a train running fifteen miles per hour. Say this is the average speed of freight trains, then figure as above, the equivalent straight and level track between stations for freight trains, north and south or east and west, as the case may be.

Table No. 2 shows resistance per gross ton of trains running thirty miles per hour or say the average of passenger train speed and table of equivalent distances must be figured out for this class of service.

TABLE NO. 2.

TOTAL RESISTANCE PER GROSS TON OF TRAINS RUNNING THIRTY MILES PER HOUR OVER VARIOUS GRADES (CURVES COMPENSATED.)

0.0	per cent.	11.23	1.0	per cent.	30.73	2.0	per cent.	50.23
0.1	"	13.18	1.1	"	32.68	2.1	"	52.18
0.2	"	15.13	1.2	"	34.63	2.2	"	54.13
0.3	"	17.08	1.3	"	36.58	2.3	"	56.08
0.4	"	19.03	1.4	"	38.53	2.4	"	58.03
0.5	"	20.98	1.5	"	40.48	2.5	"	59.98
0.6	"	22.93	1.6	"	42.43	2.6	"	61.93
0.7	"	24.88	1.7	"	44.38	2.7	"	63.88
0.8	"	26.83	1.8	"	46.33	2.8	"	65.83
0.9	"	28.78	1.9	"	48.28	2.9	"	67.78
						3.0	"	69.73

Table No. 3 shows equivalent straight and level track for down grades, since some allowance must be made while descending grades, for keeping up steam, consuming oil, etc.

TABLE NO. 3.

DOWN GRADES AT ALL SPEEDS, FIGURED AS FOLLOWS:

0.4 or over	taken as	20	per cent.	of level track.
0.3	"	40	"	"
0.2	"	60	"	"
0.1	"	80	"	"
0.0	"	100	"	"

These equivalent level track distances are determined by taking the grades from the profile of the

road, first in one direction, then in the other, and going through the method above explained. After determining the equivalent straight and level track between stations a table should be made up to facilitate the calculation of the units of work between any two stations or between such points as the trains may run without changing their weights.

The number of loaded and empty cars, and changes in number of cars, are taken from the conductors' reports.

The weight of the engine and tender must also be taken into account.

AVERAGES.

1. Dollars operating expense per dollars earnings in per cent. gives a quick summary of operations. It shows at a glance the actual profit of capital directly employed in operation. But it conveys no notion of what relation such profit actually bears to the possible profit of the property; and it shows nothing whatever of the earning power of the invested capital. If it is for a year or less period it may be made very deceptive, because the standard of maintenance may be lowered greatly without interfering directly with operation of the property.

2. Revenue per mile of road shows the relation of earnings to fixed investment. But it is very crude. If we have the per cent. of operating expenses to earnings there is nothing gained by expressing our revenue per road mile in both gross and net, but only in the net. It is only of value because it eliminates the financing element of cost of road in discounted securities and excessive interest charges, and crudely connects the earning value of the property directly with the property itself. But its crudity cannot be too greatly emphasized.

3. Revenue per train mile.—This means, of course, only per revenue train mile, thus excluding work and switch mileage. It is one of the most common averages used, but includes so many different elements, such as operating methods and conditions, density of passenger business, competition, etc., that it has little practical value except in connection with other averages which show the fluctuation of the several elements. On some roads the line between road train mileage and

switching is very hard to draw. The use of double-headers will greatly lessen the value of this average. With irregularity in the amount of motive power used, and consequently in the number of cars in the train, the train mile becomes a very uncertain thing. It registers results actually had, but does not show whether they are the best to be had or whether they are permanent or accidental. Further, because passenger and freight are thrown together, it is not possible to know whether our average is really high or low unless we further know in what proportion each kind of mileage entered into the total.

4. Freight revenue per freight train mile is open to the objections of revenue per train mile in so far as operating and commercial conditions are thrown together. Passenger revenue per passenger train mile is of more significance. While operating conditions do enter it in a subordinate way, the dominant factor is commercial in shape of rate per passenger per mile and extent of train service. The latter, for reasons of larger policy, it may not be prudent to regulate too closely.

5. The relation of passenger and freight revenue to each other expressed in per cent. of the whole revenue, means nothing of itself. But it serves to characterize the business in a general way and may be useful in connection with further information as to the nature, expensiveness, permanence, and tendency of each source of revenue. In this way it may predicate the effect of such conditions on the general value of the property. If there were shown, instead, the net revenue of each kind after direct cost had been deducted and the per cent. each was of the whole, we would have information of more meaning and direct usefulness.

6. Freight revenue per service unit or ton mile indicates the commercial conditions of operation. If there is some one leading line of low freight that enters to

modify the general average we may either have separate averages or roughly explain the general average by a memorandum of the relative fluctuation of the special low freight in tons to the general volume of tonnage. Should competitive business enter, its effect could be rudely indicated in the same way.

7. Freight revenue per ton differs from revenue per ton mile by the factor of distance being eliminated. It has no value in itself. It is only useful in comparison with the revenue per ton mile to indicate the distance hauled which could better be shown directly. It is true it does also include the element of reduction in mileage rate with increase of haul, but so vaguely that it is of no practical value. Except on a comparatively small part of the tonnage, the length of haul is not within control of the management.

8. Freight revenue per road mile, car mile, engine mile, is an analysis of operating conditions which were better studied with the variation of revenue left out; because the revenue on the particular tonnage handled never enters into the problem of actually moving tonnage. The revenue element of variation has already been measured in the average revenue per ton mile, and should be eliminated in further averages. Engines and cars are not bought on the basis of the actual number of dollars they will specifically earn.

9. Tons per mile of road indicate the tonnage density of the property. But hauling of tonnage and not the handling of it is the business of transportation. The length of haul, besides, is not a generally flexible element within control of the management. Therefore this average has little significance as an index to the volume of business for which it is generally used. It can only be useful as a detail memorandum against which to check the economy of operation in the handling of freight at terminals. The element of distance hauled had better be shown directly.

10. Tons per car mile and tons per train mile have no value. The element of distance hauled, combined with car loading in the one case and train loading in the other, has itself been measured directly. It can only enter here to obscure the element with which it is in combination, while the combination is not in itself anything useful.

11. Ton miles per car mile show the condition of the loading. It is what we might call tonnage density per car. It indicates the relation of equipment to the needs of the road's traffic, and it shows how efficiently it is handled. But the average had better be ton miles per loaded car mile, so that the empty car movement which is controlled by different conditions, can be studied by itself.

12. Ton miles per train mile give the ton density in trains. But it includes the element of empty and loaded movement and also the element of dead weight to live and weight per car. These are controlled by both the car construction and the car loading. The average is therefore composed of more than one element, each of which is given elsewhere. But it is of very universal use and a final measure of train performance. Its real value is, however, much impaired by the irregularity in the train as a unit of cost. On roads which have variously from one to three engines on a train, the train mile is only a unit of cost to the extent of the expense of conductor and flagman.

13. Ton miles per road mile are the measure of the general volume or density of business without reference to its commercial element or power to pay revenue. It is very valuable in connection with the freight revenue per road mile, as a means to sum up the effects of variations in price of service, upon the volume of business.

14. Cars per train mile show the train performance in cars moved. The same information is already had

in the comparison of the ton miles per train mile and per car mile. It is generally the custom to reduce the empty cars to the basis of loaded cars so that the element of car movement is eliminated. But there still remains the variation in loads, so that, at best, the average is not very reliable.

15. Car miles per road mile are an indirect indication of the density of the business. But so far as it has value it is already had in the comparison of the ton mile per car, per train, or per road mile.

16. Train mile per road mile is also a measure of the density of the business. But as the capacity of trains increases the average is invalidated for its first purpose. The information is all had in the previous averages of ton mile per car mile, train mile, and road mile.

17. The passenger revenue, per service unit, which is the passenger mile, shows the paying character of the business. Should it be there are one or more classes of business as commuter or highly competitive business which have a normal rate, much less than that of the general passenger business, such averages, if practicable, should be made separately. The per cent. of the whole business which they constitute should be stated. In lieu of separation of the passenger miles into any classes, the number of passengers could be used as a rough index.

18. Passengers per train mile are valuable because the train in passenger business is a sort of service unit. According to its frequency or infrequency we increase or decrease the cost for our passenger miles. But its importance is diminished by the consideration that as between different paying classes of passenger business we do not discriminate in the amount of train service furnished. The passengers per train rather than the revenue per train is the guide as to the sufficiency of the train service furnished.

19. Passenger revenue per passenger differs from revenue per passenger mile, by the elimination of the factor of distance. Unlike freight business the rate offered can in certain classes of the passenger business influence the length of the haul so as to increase the gross amount realized. There is an object in increasing the length of haul per passenger. It is not so much on account of the direct cost of handling each different passenger, such as the cost of printing and selling the ticket and sometimes the added expense of ticket collectors on commuter trains, but also because of the flexibility of the haul, that we should stimulate the travel of each passenger handled. The decline of the mileage rate due to the increased length of haul and the increased length of haul due to the decline of the mileage rate, will directly offset each other. The net result will be registered in the earnings per passenger. But to be profitable the result should increase by an amount greater than the increased train costs per passenger mile.

20. Passenger revenue per passenger train may, under some circumstances, be a desirable figure. There are the day's wages of the train service, engineer, fireman, inspection at terminals, getting up steam in the locomotive, which are fixed costs to the run. In case of branch lines with short runs and scant business, the train earnings per train mile placed against the general train mile costs of the system, would be misleading.

Passenger revenue per car and per road mile may be valuable if we apportion our car service according to the paying class of the business. But this is not generally done. Therefore the average serves no purpose, because the passenger density per car is better shown direct with the revenue variation eliminated.

21. Passenger revenue per road mile is an index to the passenger density of the road combined with the

rate of revenue. The combination is not of itself of value and the elements had better be shown separately.

22. Passengers per car mile, train mile, and road mile are of doubtful value. The only essential information which they convey had better be shown directly in the average length of haul per passenger. Taken in connection with the average passenger miles per car mile, train mile, or road mile we can know whether the increase of business is due to more passengers hauled or a greater length of haul.

23. Passenger miles per car mile show the passenger density in cars, and a careful management takes care that the passenger coach service shall correspond roughly to the volume of business.

24. Passenger miles per train mile is an average of the highest importance. It is as much more important than the foregoing, as the cost of moving an entire train is greater than that of a car. It is the passenger density per train. As before noted it is included in the average passenger revenue per passenger train mile. But here it is shown separately. Except for special reasons of general policy, the train service should be proportioned to the volume of passenger business, and this average must be very carefully watched. It can be made out of the passengers per car and the cars per train, if desired. But its importance as a summary index of the condition of train service furnished calls for its notation direct.

25. Passenger miles per mile of road are the passenger density of the road, regardless of its exact power to pay dividends. But as it is intended as an index to the passenger earning capacity of the road, only such movement as avails to produce some revenue should be included. Deadheads should be cut out, although they should be included in the passenger miles per coach and per train mile, since the deadheads were

given transportation, provision had to be made for their movement. The passenger car mile and the passenger train mile represent this provision, while in the case of the road mile there has been no extra provision for their movement.

26. Passenger car miles per passenger train mile are information which may be had from the averages of passenger miles per car and per train mile. But it is an important operating item on lines where business is dense, making possible heavy passenger trains, and should be directly stated.

27. Car miles per road mile are an indirect index of the passenger density, but not of sufficient importance to call for a direct average. The information is already had in the comparison of the passenger mile per car, per train, and per road mile.

28. Passenger train miles per road mile are a measure of the passenger business, indirectly depending for its value upon how normal may be the averages of passenger miles per car mile, and car mile per train mile or passengers per train mile.

29. Engine costs per engine mile should be shown separately for passenger and freight business, because their normal rate is different. If the relative mileage of each varies what we want to indicate is covered up.

30. Passenger engine costs per engine mile, because there is seldom any double-header business in this service, will generally be the same as that per train mile, since the engine mile and the train mile are identical. It is an exact measure of the motive power costs of the train mile.

31. Freight engine costs per train mile is a direct measure of the direct motive power cost per train mile. Owing to double-heading and light engine movement, which is common in case of freight trains, confusion may arise. But this figure should include the expense

of light mileage, because it is incurred to haul freight. Double-head trains should count for two trains.

32. Passenger train service and expense per passenger train mile shows the effect of delayed time and irregularities in wages and short run arrangements. It does not affect any other averages.

33. Freight train service and expense, per freight train mile, in the same way, shows the effects of delayed time and irregularity in the train expense, wages, and arrangements of short runs. Its fluctuations do not affect any other averages, unless in a remote contingency the train service be cut down to such a point of demoralization that heavy car repairs can be charged to inefficient train service.

34. Car repairs cost per car mile is composed of several elements. The average cannot be relied upon implicitly without reference to other items. It is affected by the number of accidents on the road, by the age of the car, by the standard of maintenance, and by the economy practiced in the shop.

35. Engine repairs per engine mile are, in the same way as the foregoing, a composite average, and open to the same criticism.

36. Miles run to a ton of coal are an index to the economy in the principal single line of expense to train movement. It should be shown separately for passenger and freight. It includes the effects of fluctuations in train loading, delayed time, and quality of coal. In case of extraordinary features of firebox construction it also includes the effects of added expense of engine repairs thereby incurred. But for the most part every decrease in this average is clear gain for which we do not have to look for compensation elsewhere.

37. Miles run to a pint of oil are not a reliable figure if, as is often true, they include more than one kind of oil.

38. Cost of maintenance of roadway per mile is a maintenance expense, and much controlled by the standard of maintenance.

39. The foregoing are simply some of the averages most commonly in use.

We use the term "average" without much discrimination. Mathematicians tell us there are many different kinds of average, of which the two principal are the arithmetical and geometrical. Railroad operations are so enormous, their detail mount up to such great totals that the average is a fundamental conception in all railroad operations. Yet because of the law of increasing returns, railroads peculiarly offer the conditions which may make the use of averages most misleading. It results in the fallacy that the added hundredth passenger will cost as much to haul as each of the ninety-nine whom we have already assessed. Or we fall into the absurdity that to pick up a thirtieth freight car will increase our train costs by an amount as much as each of the twenty-nine have already cost.

40. By an "average" the railroad man would imply the arithmetical average of the ratio between two things. The things whose ratio is averaged may be in original units or reduced to their money equivalents. An average is a composite photograph. Things to be taken in a composite photograph must be known to be similar. No one would think of taking a composite picture of a man, a hyena, a switch tie, a poll parrot, and a sunset. The underlying notion is that we are dealing with things or conditions into which certain elements enter, exist, disappear, and re-enter. The elements are either the essential things sought or the things to be reduced to a minimum, but from which we may never be wholly free. Thus the revenue miles per passenger are dependent on certain conditions which we seek to foster, while the injuries per

passenger mile are an index to conditions which are always present, but which we seek to reduce. Both exist in all passenger transportation as a whole. They may enter or disappear in single instances; but the theory on which all practice rests is that there will be a certain recurrence which has the regularity of a law and may be reduced to quantity. We take its ratio of actual occurrence to possible occurrence as a definite thing which we conceive to be regularly present in all operation.

41. To state the theory of an act,—it is a body of causes applied, from which the desired result, or group of results, is produced. Together with the desired results will be a vast mass of inefficient results which are waste, since because cause and effect are always equal they represent so much expenditure of energy and material that serves no purpose. But while we do consume as much energy and material as we produce, yet the utility of the product, if we make anything, is greater than the utility of the things consumed, and this difference is the value produced. The efficiency of an act will depend on the amount of this margin. This margin can only be expressed significantly by the ratio of the utilities produced to the utilities consumed. Our use of averages will be mainly to determine this. It may not always be an act which we would examine in this way, but the kinds or quality of material, or the nature of conditions with reference to their efficiency or detriment to certain results, would be quite as important to determine.

42. To follow out the idea in a concrete form, let us take the case of mining ore. Let us assume that for some reason the lead does not closely follow the vein. To-day our iron runs at 70 per cent., and next week at 75 per cent. But as we veer in and out along the vein we estimate the efficiency at an average each day of 72½ per cent. For every time the vein turns out of

the lead it will also turn back; and so it passes in and out of the mass which we take out, in digging out lead.

When every unit of our product of iron is in a fixed demand, then the only uncertain element is the per cent. of iron to the measure of ore. If this were constant, our result, or the iron in our ore, would be an exact function of our cause, or the general body of ore. If this were inconstant, our result through a long period of time would equal this function, which would be the average of all the variations during that time. But suppose that our product that would normally make 72½ per cent. each day is used irregularly each day, and the amount left over from any one day cannot be used on any subsequent day, but must be permanently wasted. Then not only would the units of result, which are the pounds of iron produced, vary in their ratio to the amount of the ore mined, in any one day, through fluctuations in the quality of the ore, but also through fluctuations in the utility of the product. Thus we have acts that differ according as the efficiency of the applied causes varies, or the utility of the result varies, or as both cause efficiency and result utility are simultaneously subject to variation.

43. A ratio that absorbs both variations is an absolute index to the conditions of past and present operations. But then it hardly does more than state concisely, and in a single figure, the general condition. For instance, our road's expenses may be ninety per cent. of the earnings, which is an exceedingly bad showing, but this does not indicate the fault. In studying any conditions our analysis is to find those causes that are within remedy and those that are beyond remedy. The per cent. of earnings to expenses does not show whether the fault is in the expensiveness of operation or in the dearth of business.

44. The purpose in using a ratio is to express the

efficiency of a sequence directly, or indirectly by expressing the inefficiency or waste. Either quantity to have significance must be placed, either against the whole body of results, or the whole body of causes, or each against the other. For example we will suppose we make 100,000 car miles with the result that 70,000 of these were loaded and 30,000 were empty. We may either express this 70,000 against 100,000 or against 30,000; or we may express this 30,000 against the 100,000. In this case we begin with 100,000 car miles, which result in 30,000 empty and 70,000 loaded. The sum of the outlay, or what we begin with, and the sum of the result, or what we end with, are in the same unit. Hence we have the same number of units on the cause side as on the result side. But suppose we begin with train miles instead of car miles. Then we would have different units on each side and we could express our performance as 70,000 against either the number of train miles, which we may call 4000, or the full number of car miles, which is 100,000.

45. Since we can never show, nor even know all the results, it must always be borne in mind that the inefficient result which we select as the most considerable, is yet only one of the many such that are produced at the cost of the causes applied. It may not even be the most important item of waste or even a significant item at all.

46. Our acts or sequences will divide into simple, compound, and complex, that is, into those having one principal cause to one principal result, as cars per train, or compound, where we have two or more principal causes to one result, as coal, engineers, and firemen per train mile, or one cause to two or more coincident results as mixed train mile to passenger miles and ton miles made. The complex have two or more principal causes to two or more coincident results, as mixed train costs to the mixed train service performed.

47. Our simple sequence involves no difficulties. The variations may be on the cause or on the result side, or both. We take some one unit on the cause side that is a measure of the body of causes, and we express the ratio of this to the result unit. Where the variation is on one side only we measure it exactly. Such a case would be cars per train, tons per car, tax per month, or mile of road, transfer expense per passenger, etc. Really there is no case where there is one single prevailing cause to the result; but the several causes may be gathered into some one unit, as the car mile or train mile, which is an approximate unit of all the body of causes under discussion. The significance of such a unit depends largely on expert knowledge of what causes it contains, and it is most especially used in technical discussion.

48. Our compound sequence, to put it in shape of a single quantity, we may reduce to its money equivalent. But in case the elements are not reduced to money we may apply one element at a time on one side to the unit on the other side. In case they stand in a fixed ratio among themselves on one side, as water and coal for engine miles, that is, in case they are not entirely or partially interchangeable among themselves, any one may be taken as a partial index for the mass where it occurs. Its single ratio to the other side then registers the efficiency of the sequence. It is not always necessary to discuss these in the money equivalents of the units examined. The original units themselves may be used. As an example, we are studying the decreased cost per ton mile. We want to know how far the decrease in cost is due to the law of increasing return. Into our cost per ton mile we know there have entered the fixed costs of distance hauled, train miles, road miles, and tons handled. To discuss it with reference to operation, we know what are the elements of operation directly and indirectly necessary

to this ton mile movement. They are, as it were, the different dimensions of this cost, each in its different unit, which cannot be reduced to a common basis with any other unit. We, therefore, can never know in exact value, how far the increase or the decline of the ton mile cost is directly due to the variation of each cause that enters into it. But, by expression of the average ratio of each unit in turn, against tons, we can ascertain which elements have had an increased efficiency or utility, and so have tended to produce a decreased cost. But the contributory value of such decreases to produce the gross decrease must be a matter of judgment.

49. We have designated as "complex sequences" those cases where there are several mixed causes to several mixed results. They are exceedingly uncertain things to deal with. An example would be the case of water, coal, and other engine costs, on one side, applied to an engine serving intermittently as a passenger and freight locomotive to determine how much more expensive the helper service was than the passenger, in pounds of coal consumed per mile run. Or, again, an order fixing the minimum loading of cars is strictly enforced in the less than car load business. Complaint arises that freight is inordinately delayed, waiting for full loads, and it is badly damaged in the handling because so overcrowded in the car. On the other side we would have, as possible cause, the overloading of cars of light, bulky freight, or the slovenly work of the station laborers and agents. On the other side we have the increase in the number of claims for delayed and damaged freight. Perhaps we may further have the delayed time of way freight crews and much increase in the "working" of cars at terminals, since we would have to break bulk more frequently. The statistician would have to determine by comparison with other things, when either of the two

causes was abnormally present, and at such times he would note the effects on the results.

50. The sequences which we measure may be anywhere throughout the whole field of operation. They may be the costs to certain results, which in their turn become the costs to further results, and so lead up to the final result or revenue of the road. They may be successive links in a continuous chain or they may be separated by several intermediate links. Or they may be the co-ordinate links in a bifurcation of the chain. Even further, they may be the link in one bifurcation compared with the link in another and subsequent bifurcation. The more remote and indirect the relation the less significance has the average.

51. There are four great units of operation. These are the unit of the general property, which is generally taken as the miles of road, the train unit, the car unit, and the service unit, which is either the passenger mile or the ton mile. The ultimate costs of the service unit is the total cost of each preceding unit, prorated successively over as many of each next lower unit as there are lower units to share in the fixed costs. Therefore its final cost depends first on the aggregate cost and next on the number of units that can be made to share that cost. The final cost to the service unit as we have already noted, must include the risk of fluctuation in direct cost and risk of fluctuation in usefulness or demand of each of the elements that have gone into it. So far as possible we want to compose our averages so that only one of these elements is present at a time. If the other is not absolutely known it is approximately known, or indicated by information from other sources or other averages where it is in different combination.

52. The temptation is to place all sorts of elements in combination, however remotely related or however widely separated by various unmeasured conditions.

For instance, the average maintenance of way expense per ton mile, or conducting transportation, maintenance of equipment, and general expense, per ton mile or per train mile, carries no significance. It only shows the relative proportions of each expense by using the ton or the train mile as the datum against which to measure it. This could be far better expressed in per cent. It may be urged that the grade of service on the road, so far as it is within regulation, is proportioned to the volume of business. But this is done far too rudely to make it the basis for an average.

53. The same criticism applies, though perhaps not in the same degree, to the frequent comparisons made between English and American locomotive "earnings." The fallacy of this method is still further apparent when we take things that are not essential, but are more or less alternative, as earnings per yard of ballast when some roads may have very little ballast or no ballast at all.

54. In case of comparison of English with American road mile earnings we are for the most part comparing single-track road with double- or even four-track road. Or should it be that they have both the same number of tracks, and so the same normal efficiency for car movement, the comparison is misleading because the English road, on account of local conditions, represents a far greater outlay per mile. If their operations are successful, this excessive cost must be reflected in greater earnings per mile of road. Thus we see that our comparison between such road-mile earnings and American road-mile earnings gives little information.

55. It is a favorite practice to take single elements of cost in their original unit and place them against the general revenue of the road. Such an instance would be earnings per locomotive, per train mile, per ton mile, per car mile. In doing this it is necessary that

the normal contributory effects upon earnings, of each unit selected, as the engine or the train or the car, remain about constant. This is necessary because we take the particular unit that may be selected, as an index of the general body of causes, or else as in itself a considerable item to be discussed. We assume that it is a permanent and indispensable element of operation that cannot be displaced or affected by any alternative method. Such comparisons serve primarily to show up earnings. They do not show the efficiency of the specific cause units. This could better be shown in terms of the direct results which they produce. For instance, we showed earnings per tie and suppose that between two exhibits we changed from the use of wood to steel ties. The normal cost and the normal efficiency of our ties has now changed. Therefore their normal relation to periodical earnings has changed. But since this normal change is not accurately known, such change as we note in relation to earnings will only indicate a confirmation of expectations. It will not do this with any accuracy and it will discover nothing new. Or, for further example, suppose a comparison between English and American car-mile earnings. Our results will indicate that the English car mile must be smaller, because it points to a smaller ton mile product from each car. But the comparative efficiency of the two cars to produce ton miles could be better shown by multiplying the car miles made by the average rated capacity or by the average load, as desired.

PRORATING.

1. So far as possible, costs directly affected by the amount of the product and earnings largely determined by the amount of the outlay, for purpose of prorating, should be withdrawn to a class by themselves. On the other hand, expenses that have no direct relation to the amount of the product, and those earnings that do not depend on the amount of the outlay, constitute another class to be handled separately in prorating. Prorating is the term used for distributing earnings and expenses to actual accounts, statistical accounts, and geographical or other physical divisions. No prorating should be done until most of the statistical deductions have been made.

2. In dividing to statistical accounts, or subdivisions, the same general principles are employed as in dividing to actual accounts. But the bases may be different, because in dividing out a general expense or joint earning to the different parts of a single property, more of the inequalities may be equalized than when the division is among separate interests.

3. Maintenance of way, section foremen's time, should be prorated over the labor of their men. Work-train expenses usually will be best apportioned on the basis of the labor distribution of the floating gang that works with it. "Superintendence," "stationery and printing," and "other expenses,"—"maintenance of way," are sometimes apportioned on the basis of the labor charges and again of the road miles, but the former is the better. The same is true of "superintendence," "stationery and printing," and "other expenses," "maintenance of equipment."

Gang foremen's wages in shops should be apportioned in the same way as section foremen's wages. Storekeeper and clerks' salaries and expenses should be apportioned on the basis of the invoice value of the supplies issued. But heavy supplies of miscellaneous issue should be withdrawn to a separate class, which should be a less rate of storekeeper's costs. Engine repairs should be apportioned by engine miles, by kind of service. Car and coach repairs should be apportioned by their respective mileage. When the whole system is under one operation the expense of repairs due to accident caused by negligence of operation should be shared by the whole system regardless where it occurred, on the basis of the car or engine miles respectively. This is the only reasonable basis of apportionment, since the entire road being operated by the same management, all parts were equally exposed to this contingency. Shop tools and machinery charges should be distributed on the basis of the work done in the shop. Maintenance of terminals should be distributed over the system on the basis of tonnage handled to and from each division, car load, and less than car load. Docks and wharves maintenance should be handled in the same way, as also large river crossings where no arbitrary is exacted.

4. The old method, now generally discarded, of prorating maintenance and joint expenses to passenger and freight on the basis of train mileage, has no foundation in reason, in case of most of the items so prorated. Such items as are already separate should be held separate. There will still be joint items that can be separated, on the basis of their known relation. But for the remaining items, train miles is neither an approximate measure of their wear and cost for each service, nor of their use and benefit.

5. Roundhouse expense should be divided on the basis of engine miles. In the same way, engine ex-

pense should be divided between services where the engine may be used in two or more services. Terminal expense, including station service and station expense, and switchmen and yardmen, should be apportioned on the basis of tons handled to and from each subdivision. Switching disabilities and "operating marine equipment" should be apportioned in the same way. "Superintendence," "stationery and printing," "other expenses," and "telegraph expenses"—"conducting transportation," should be divided on the basis of train miles, ton miles, and train miles respectively, for the same reason that accident repairs to rolling stock were apportioned on the same principle. "Advertising," "outside agencies," "salaries and expenses of general offices," and the undistributed law expenses should be apportioned on the basis of the net earnings. Such net earnings would be had by deducting all other operating expenses from gross earnings. Taxes on engines should be apportioned according to engine miles. On coaches and cars the taxes should be apportioned on the basis of their respective mileage on each subdivision. In case of cars it is true that twenty to fifty per cent. of the mileage is on foreign roads. But if the car interchange is fairly even, assuming that the mileage rate charged is not high enough to include taxes, it is yet true that for every home car, whose use is temporarily lost, there is had the use of a foreign car. Therefore, car mileage is an equitable basis for apportioning taxes. On the assumption that it does include taxes it is also equitable because the same rate is charged for foreign cars had in exchange.

6. Perhaps nowhere does the inherent fallacy of prorating, as often understood, become more apparent than in the effort to apportion on basis of road miles the profit or loss by those parts of the property that have no relation to specific road miles. Such parts of the prop-

erty are cars and coaches. It is plain that in the proportion that each subdivision used equipment it tended to produce the excess of demand for equipment over the supply, which brought about the debit car mileage or equipment hire balance. Therefore the obvious basis is the car mileage actually made on each subdivision. And since an earning in its relation to other things is simply the converse of an expense, each subdivision contributed to the net credit balance of car mileage and equipment hire in the proportion in which it did not use the equipment, and so made it available for exchange and hire to other roads.

7. Joint operation among railroads takes all conceivable shapes and extends to every degree of consolidation. We will give a few of the more common forms.

8. In stating the cost of operating a Union passenger depot, taxes, rent, interest, depreciation, and repairs should be kept separate from current expense. The latter should be charged on the basis of the number of trains handled, which, as far as possible, is on the basis of cost. Any special conditions to modify the character of a train, so that one draws on cost more than another, because it has more mail to handle at an awkward hour or has traffic that involves extra difficulties to handle, or must be inspected, watered, or made up, should be considered. The fixed charges may be apportioned on trains or cars or number of tickets sold or any other basis of benefit, which must depend on the extent to which favored and unfavored roads share their several inequalities of condition.

9. The expense of a union freight depot should be separated in the same way, into the direct costs and the fixed charges. The former should be charged on the basis of cost, which generally is best measured by tons handled, though special conditions may enter to modify this. The latter will be variously prorated accord-

ing to the degree of joint operation to which the associated roads have consented. The first basis will be simply the number of roads, each road sharing equally. The next basis may be trains handled, and so on, to tonnage, ton miles, gross revenue, net revenue, etc.

10. A joint soliciting agency is, for the most part, a fixed cost from month to month. Its expense should be apportioned on the basis of the benefit received. The immediate unit of benefit is tonnage secured. The next basis would be ton miles, and then their revenue, and still further their estimated revenue. What shall be the basis of their association depends entirely on the original relation of the roads at interest and what mutual concessions may have been necessary to bring about joint operation.

11. A railroad grade crossing is as necessary to one road as the other, regardless of the relative volume of business or number of tracks, so long as the road continues to operate according to its standard of operation. The cost of the interlocking plant should therefore be borne equally. But any subsequent tracks that are put across by either road are made necessary by conditions that have arisen later. As they would so far destroy the original footing on which the roads stood, they should be charged for separately. Also if there are any violent fluctuations in train movements or changes in operating methods, the current expenses should be apportioned on the basis of the direct cost.

12. Roundhouse service at terminals should be separated into the parts of current and fixed expense. The former should be divided on basis of engines handled, due regard being had to any special conditions that may enter to affect cost. The fixed expense should be apportioned on any basis of benefit which the degree of joint operation may justify.

13. Dining car expense should be shared on the basis of road miles of through line, regardless of the num-

ber of miles the car actually ran on each road. Through passenger service should be apportioned on the basis of the coach mileage. But if a sleeper is used on only part of the line, there may be conditions when its expense should be charged to the entire line and not to that part only, over which it actually ran, as in the case of the diner.

14. Joint switching expense should be divided into the fixed and the current expense, and the latter apportioned directly on the basis of cars handled, with due consideration for modifying conditions that may enter. The former part of the cost should be apportioned on basis of benefit, either in cars handled, or tonnage or resulting ton miles, or revenue or net revenue, according to the arrangement of the contracting parties.

15. Joint use of a building is sometimes apportioned on the basis of floor space. Where this is the basis on which the original rental is paid to the landlord, it is a direct unit of cost. A telephone that is used in common, if the necessity for the telephone was equal, will be paid for in equal shares; or, if one or more of the parties finds the telephone has a value to him, but not equal to the value which it has to the other party, they will properly divide the cost on the basis of their respective need for the telephone.

16. The extent to which terminal expenses, switching disabilities, bridge tolls, cost of operating extraordinary grades, and like special conditions of individual roads, which are parties to a through line, shall be shared by all the roads of that line, is a special question for each particular case. The basis that may be used to apportion such expense where it is allowed to enter, depends on the degree of joint operation adopted, by which inequalities become the common property. This in turn depends on the relative advantages and disadvantages with which each road entered the line.

But instead of apportioning such costs as expense, they generally enter as modifying considerations in deciding the basis of dividing the joint revenue, either as arbitrary amounts, arbitrary per cents., or constructive mileage.

17. Prorating exists among railroad men to the extent of a malady. There is infatuation in the idea that we may charge out every dollar of cost to the work done on the basis of exact cost. The public have not been slow to follow the lead of the railroad men and demand an absolute figure for the cost of the passenger and freight service, even to each detail of facility offered. But, as so often shown, this cost per unit depends not only on the variable amount of the cost actually consumed, but also on the variable amount of the usefulness of the product. It is absolutely impossible to devise any unit that can be a reliable measure simultaneously of the fluctuations of the cost or supply side and of the result or demand side. The proportion of the whole expense that can be prorated on the cost basis varies greatly with different roads, and even with different conditions of the same road.

18. The tendency is constantly towards a larger and larger body of undistributable costs on every road as its operations extend. Beginning with those costs that may be applied direct to the results obtained, they shade off by imperceptible degrees to those costs that have no direct reference to the current volume of business whatever. These must be prorated on the basis of the utility to each service unit produced, or, as it is generally put, on the basis of "what the traffic will bear."

19. Not only does the temptation to prorate arise in the effort to get at the cost to the public, of particular service units, but it occurs all through railroad operations in distributing costs to intermediate results which they produce, as replacing ties per tie, ballasting per

yard, car repairs per car mile, water supply per engine mile, etc.

20. Because the line between the distributable and the undistributable costs is hard to draw sharply, and because it is changing all the time as the road perfects its plant, and because where distribution of doubtful items is attempted, the basis differs on different roads, it is unsafe to rely too securely on comparisons of such figures between different roads or between two widely separated periods of the same road. As a sample of the random way in which prorating is sometimes done we have often seen one earning prorated to subdivisions on the basis of another and entirely different earning to which it cannot bear any possible relation. Or again, a general manager of several associate roads operated jointly, had been so unfortunate as to lose a pig out of a stock pen at a junction in his through line. After careful investigation it was found that the pig actually escaped on the south side of the particular pen, and therefore it was gravely decreed that the road that operated on that side of the pen should bear the entire expense. This weighty decision ignored the fact that the same pig, had he so chosen, could as easily have escaped from the north side of the pen, since all sides were equally in bad repair.

21. On a certain performance sheet the water supply was prorated to engines on the basis of tons of coal handled, and grave deductions were made about the relative water consumption of different engineers. Still again, the switch engines were first assumed to consume per hour an equivalent of what a road engine would in six road miles. On this basis the costs were apportioned to switch engines. Out of this they undertook to show how much it cost to run a switch engine one mile. Such reasoning is like a man trying to lift himself over a fence by his boot straps.

22. We prorate to different accounts, but also cross-

ing over without thought from accounting to statistics, a great many railroads prorate to subdivisions or individual engines or cars or bridges, every single cost they have, in the hope of arriving at a final figure of expense to each, which can be closed into an accounting total that shall balance with bookkeeping nicety. The direct costs to particular services are a small proportion of the whole, but the direct costs to small sections of a through line are even far less. The accountant is not altogether at fault here, for this is demanded by his management, it is demanded by the public in their State reports. Anything less must leave his accounts in a lot of fray-ends which are disorderly and demand that they be in some way tucked away. For accounts that represent different ownership this must be done, however rude and inaccurate the basis that is possible; but for statistical accounts there can be no gain while there is the possibility for a vast amount of harm by offering the basis for misleading deductions.

23. Prorating is the apportionment of a quantity on some exact or proximate unit, either of the thing itself or of some other thing to which it bears some known or assumed relation. In case of an expense, this thing to which it bears some known or assumed relation is the earnings. In case of an earning it is the expense. In case of a cause it is the result; in case of a result, the cause. The conditions under which a cost or cause may be apportioned to its revenue or result are very diverse.

24. Let us take the case of a pattern maker who consumes ten hours making four patterns of the same kind. If he made one pattern at a time we could assemble all the hours applied and charge them direct to the single pattern. If he was making the parts of all of them together and no one was completed until all were finished, then to find the cost of the pattern maker's time to each we would divide ten hours by four

patterns. But it is an intellectual conception merely. However, it is practical, because if he had made five patterns instead of four it would have taken him 12½ hours. So while the cost to no one, taken singly, can be known, yet each bore on the cost in hours equally, and the amount of such effect on cost can be computed at 2½ hours. So far we have limited our consideration of costs to the element of labor only. We will assume it was ninety-five per cent. of the body of direct costs. Even the labor was of irregular efficiency. Perhaps the morning hours were worth ten per cent. more than the afternoon hours, but the hour was the unit at which the labor and current shop expense of oil, heat, power, and wear of tools was charged. In time he engages to put on the trade mark of the manufacturer for whom he makes the pattern, free of cost. Perhaps he will ship by express prepaid. He engages to repair free of charge, possibly to warehouse patterns, and carry their insurance until finally our first cost of labor, we may assume, has become less than fifty per cent. of the actual direct costs. It, however, is still the basis on which cost is computed—the whole direct cost is divided out on the basis of labor applied. Plainly this is just, to all, only so long as labor is, in all cases, a steady proportion of the general body of costs. If at any time one party enjoys express or repair service to a greater extent than another, he is getting a benefit but escaping his just proportion of the expense, which is imposed equally on all, regardless of whether they participate equally in the benefit.

25. It is thus that the units on which a service is computed may become very inexact, as mere measure of the cost. An instance is the ton mile, which is so generally thought to be a certain measure of the direct cost, even by those who see its fallacy as a measure of fixed cost. Loading, unloading, terminal delivery, in-

surance, bulk, condition of packing, extent of distribution, gradients, alignment, climate, are, however, with distance and weight, very large elements of the body of costs that can vary widely and are beyond the control of operation. According as they enter in various combination of degree the body of cost may vary through wide ranges, although the inflexible unit of ton miles is strictly adhered to as a measure of that cost. Undoubtedly the ton mile is the best single unit that has so far been offered, but its value must always be qualified by the other elements that enter with it.

26. Recurring to our pattern maker, let us dispose of his cost of shop and tools, taxes, rents, and repairs. Suppose that he sometimes turns out a different kind of pattern that is used for a different kind of casting. If they were alike he could spread his fixed costs over all patterns on the basis of his average output. But his different kind of pattern, although it may cost the same in direct outlay, is useful for a different purpose, and in a different degree. With its different use a new condition has entered. He cannot call one new pattern equal to one of the old (unless the shop's full capacity is used and it displaces one of the old), for he may with equal propriety put them in any ratio so far as their relation to fixed costs is concerned. After all, what made one pattern like another in the case where they were all of one kind, in their relation to the fixed costs, was that they normally served the same and equal uses. Intrinsically he was charging his fixed expense to uses. Therefore, assuming in our example that the times a pattern is used is in all cases an equal measure of its utility, we may apportion our costs to the two kinds of patterns in the ratio of their use. These utility units become the basis on which we divide out the cost. In fact there is no other unit conceivable. Since the thing itself is inseparable and indivisible we have no recourse but to

divide it on the basis of some other thing to which it bears some assumed relation.

27. Therefore where we cannot apportion a cost in the proportion that each result bears on the cost, then we must apportion it on the basis of the net benefit or value of service. We do this first because there is no conceivable way to divide such cost to result directly, since they have no direct relation, and next because by apportioning on the basis of value of service we are simply following out the principle of charging on the basis of cost, because every cost is supposed to bear fruit proportionally in benefit.

28. As an instance, under the above head, the cost of running a passenger train over a division, within limits, has no relation to the number of passengers, nor the distance each is hauled, except for the personal injury risk. Being a subordinate item, for the present we may leave this risk out of consideration. Each passenger who uses that train has caused the expense of running it, equally with every other, and on a strict apportionment of the cost we should divide the expense equally among all who used it, irrespective of the distance carried. The public, however, have gone further. They have recognized that each passenger did not get an equal use out of that train and they have taken the passenger mile as the measure of that use and conceded the justice of tariffs based on that principle. They, however, have considered this the unit of cost and have upheld the basis as equitable because the costs were shared equally, whereas we see that the unit has almost no relation to the direct expense. It is true that potentially the passenger mile has made necessary the roadway mile, the length of train run, size of car, and number of cars per train, but the relation is so indirect that it cannot be charged to specific passengers and passenger miles on some single rigid basis.

29. Therefore from the foregoing examples we see there are cases in which the cost is direct to the single result. Next, it varies directly with the whole number of results admitting of a direct division of the cost among the results. Again the unit on which we divide out the cost is only a proximate unit of the mass of cost. Such charges, we may say, are on the basis of cost, because they are direct divisions of costs to the things to which they apply, and these things stand on an equal basis in their relation to cost. But next we have direct costs to two or more kinds of results jointly. We may not be able to assign the cost directly to the result units, on the basis of their number, but experimentally we may determine the ratio to each other in which each affects the joint expense and apportion a part of the cost directly. There will still remain a proportion of the joint expense that has no relation to the relative amount of each kind of result, and this must be apportioned to each on the basis of benefit.

30. Next we come to fixed costs to a variable number of results of the same kind. There is almost no relation between the cost and the number of results. If our number of results were definitely fixed, although they had no relation to the cost, we might yet divide out the cost among them equally and arrive at an intellectual notion of the amount by which each unit contributed to make the full expense. If, however, not fixed, but still of the same kind and so impliedly of the same degree of use, we could divide out the cost over their average number.

31. But generally the variation in the number of things produced, having the same kind and degree of use, is not great. The variation in the volume of such utilities is largely due to the different degrees of use or different kinds of use that may be made to participate in the benefits of a fixed expense. And this brings us

to the final stage, which is two or more kinds of result units to a fixed cost. This is the form the great part of railroad operations take. The fixed cost is apportioned on the basis of the result unit or benefit. The apportionment of the benefits may be reckoned in a common unit, but as the degree of benefit is various the various measures of utility are provided for in the different rating of this common result unit, which practically in this way becomes several different kinds of result units.

32. The instant the principle is accepted that the services rendered are not all of equal use, although they may be in the same unit; that the service unit, either ton mile, or passenger mile, is not a thing of equal use to all who enjoy it, we see there is practically no limit to the range within which this use may vary, from no value on one side to an undetermined value on the other side. The conditions that make a given service of more use in one case than in another are outside of those that control cost. They are special to each case. The service, therefore, will be classified by those groupings of conditions which variously determine its value or degree of use. The degree of use, as before noted, is expressed either in the various kinds of units, which successively eliminate special inequalities among the individual consumers or in one unit variously rated. For instance, the expense of a union passenger depot is prorated among the users on the basis of the trains handled, but another road whose passenger business is so light that most of it is conducted on mixed trains, will perhaps insist if it enters the depot, that its apportionment be not on trains handled but number of tickets sold. And as an instance under the other head, every freight rate rests on the basic notion of a common unit compounded of distance and weight, which is variously classified and

rated according to the value of the service to each class of conditions served.

33. When two or more parties prorate a cost together on the basis of its respective usefulness to themselves, so far as that cost goes they are equalizing their differences of situation; the favored one is giving over to the other the advantages of his position as against the other. Take the case of two railroads at a junction. If they act independently, each must build a separate depot at a cost that is practically the same. The first road, we will say, has use for 75 per cent. of the capacity of their depot, while the other road can use only 25 per cent. of its possible usefulness. The latter is at a disadvantage of 50 per cent. to the extent of the outlay for depot facilities at that point, placed against their contribution to earnings. If they occupy one depot jointly, at practically the same cost in the aggregate as each sustained separately, the disadvantage may still remain at 50 per cent., but it will be 50 per cent. of a smaller amount. If now they divide the rent of the new station on the basis of the trains handled, they will be basing it on the usefulness to each, one degree nearer to ultimate utility. By this much they will be further equalizing original differences. Let them advance a stage further and prorate on the basis of cars handled, or, even further, on the basis of tons received and forwarded, the differences will be still further equalized until we can theoretically come to a division on the basis of the net contribution to earnings, by the joint facilities enjoyed. Then the original advantage of the first road is entirely wiped out.

34. The two roads have saved to themselves the cost of an extra depot. It is entirely natural and proper that the road at a disadvantage should ask that its relative disadvantage be not increased. Originally

it was under equal necessity to maintain a depot at that point regardless of the volume of its traffic, and the utility of such facilities they still enjoy, though now jointly. But when the unfavored road asks for a basis of trains or cars or tons handled, it is seeking to equalize a difference of situation with which the building of the depot has nothing to do. The favored road, in building the depot, has made to itself a definite saving, and it might reasonably be asked to equalize the disadvantages at that point, but it could hardly be asked to go further and share with its unfortunate connection the mishap of a thin traffic over its line generally, so far as such traffic was called upon to assume the burden of this depot.

35. Therefore when two or more parties unite in an expense, it should be apportioned to each on the basis of the usefulness to each of the facilities which they enjoy in common; but ultimate utility depending on conditions outside of those enjoyed in common should not be allowed to enter to modify the basis of dividing the expense.

36. When the same unit of service is charged at different price to different people, or awarded a different value according to the different parties performing it, there would appear to be an injustice. If the unit involves direct costs, and one unit is low at the expense of another which is high, or if an earning involves direct earnings, and one earning is high at the direct sacrifice of another, there is actual injustice. But if the expense has no direct relation to the actual units over which it is spread, and the earnings have no direct relation to the parties who participate, there is no injustice in an unequal apportionment of the units apportioned. The equality must be maintained in the amount of benefit severally sacrificed or enjoyed, and this equality of benefit is not necessarily expressed in equal amounts of the same unit. For instance, there

may be no injustice in dividing the revenue between a branch and a trunk line in an unequal proportion of ton miles, or in carrying competitive freight at a different profit than local freight.

37. It is not necessary that the conditions that give different value to the same form of service be physical or legal or even of remote traditional origin. So long as they exist and are beyond the control of the business so conditioned, they are real. One city is on a waterway, and its competitor is not. It is generally conceded that the railroad meeting water competition may exact less profit on its business than the one having no water competition. But a competitive road is quite as real a thing as a waterway, and just as real an advantage to the favored city.

38. There was never any hard and fast rule by which we may determine what is the equitable apportionment of an earning or an expense. Where we deal with separable interests that may accept or decline, enter or withdraw at pleasure, each acts for itself and protects itself. But railroads peculiarly are a tremendous aggregate of individual interests, in all degrees of relation, bound into a single organic whole. Not only is this true of the railroad property itself, but of every interest which it serves, to the extent that such service enters into its business. The proper adjustment of all their confused interests is the finesse of equity. The individual interest has long ago lost its power of withdrawal, but its treatment must accord with the conditions which existed at the time that it gave up its freedom of individual action. However, as no conditions are permanent, so these special advantages to each interest, had it stood alone, would not have always continued. As their traces are gradually obliterated, the several interests will slowly lose their identity and come more and more to share the general fortune. Then the direct earnings of any part are such as could be

made independently of its association with the other parts, and the direct expenses are those which were incurred specifically for this part. The joint earnings are those in which outlays or advantages peculiar to each have been united for a joint product, and the joint expenses are those which have been incurred jointly and cannot be separated, but result in benefits that must be specifically apportioned.

39. Joint earnings should be apportioned on the basis of the outlays and advantages specifically contributed by each. A main line divides its joint revenue with a feeder, giving a constructive mileage to the latter. This is correct, because not only is its expense per traffic unit greater owing to inferior traffic density, but also because the branch line may have contributed certain monopoly advantages; or the main line may have been a bad investment, while the investment in the branch line was yet free capital. Unless they are under a single ownership their association does not extend to the equalization of all their specific conditions. In entering upon any arrangement each party to it begins with certain conditions of natural advantage or disadvantage. What they save or gain by any united action should avail to each in the proportion that shall make the net gain to each the same when all considerations potential and actual have been balanced. It is immaterial to the question whether these are accidental or real conditions so long as they exist. To come at a basis for division intelligently, the contribution of each road in current expense for joint account and fixed charges for investment and any estimated monopoly values on property used jointly should be stated. The total of this expense per service unit, at the average volume of business for each road, becomes the basis of its claim, with all other parties, in apportioning the joint earnings.

40. Joint expenses should be divided on the basis

of the benefit enjoyed by each. This joint benefit may be reckoned in immediate result units common to both, as a roundhouse expense apportioned on basis of number of engines handled. Or it may successively take up each inequality of condition and apportion the expense on the final earning efficiency of the service, which would be the net profit on the business affected by this terminal service. Such successive stages would be car rating of engines, actual cars hauled, car miles, ton miles, gross revenue on such ton miles, and finally net revenue. The absurdity of the last basis is entirely obvious, but it is given to show how the area of a joint operation can be extended.

41. Direct expense should be apportioned on the basis of cost, so far as practicable. Perhaps in some expenses there is no exact unit of cost, but it rests on the notion of average occurrence, as engine repairs will be charged out on the basis of engine miles. Others can be directly divided into their parts, as taxes on rolling stock on basis of car days, or car miles where this is impracticable.

STATISTICS.

1. Railroad operation is on so vast a scale and involves such intricacy of relations that it can only be stated and known statistically. Since any inquiry into the conditions of a railroad property, or the standard of its operation, involves the use of statistics, we cannot go far in any knowledge of railways without a thorough familiarity with the statistical method. Theoretically, railroad statistics deal with ever-varying conditions which admit of no rigid classification. To-day one set of dominant factors determines the fluctuations of the mass; to-morrow an entirely different arrangement is necessary to locate the controlling causes. For instance, this month a certain outlay on a bridge is due to the normal necessity for repairs. The next month a broken axle wrecks a train on the bridge and demolishes the bridge. The ordinary bridge maintenance is an exceedingly small part of the extraordinary charge to this account. The dominant cause has now become train wreck, and not bridge repairs. Pure statistics would deal with it as such.

2. But if such a disaster is of reasonably frequent occurrence, and inseparably connected with bridge maintenance, it is simply an element of bridge maintenance. Together with the many other elements of atmosphere, weather, weight and speed of trains, etc., it goes to make up the cost of keeping the bridge in condition for use. The bridges must be maintained. The conditions against which this maintenance must provide may vary from month to month. But the outlay they make necessary in their various ways is for the single result of keeping the bridge open. So

we set up the account of bridge maintenance, and charge expenses of all kinds affecting the bridge to this account. Thus we adopt a set classification of causes that shall exhibit the operations from month to month. For convenience we may call the figures so compiled "record statistics," as distinguished from a more elastic method of analysis, which we have arbitrarily called "pure statistics."

3. "Pure statistics" do not begin with the known cause, while "record statistics" assume the cause and measure the sequence. "Pure statistics" combine and recombine various elements to locate causality and measure the sequence. "Record statistics" deal with a rigid combination of elements.

4. In railroad operations the heterogeneous elements may be reduced to a common unit in dollars. In tracing causality we may pick out of the mass on the cause side the element for which we want to find the corresponding result on the result side, and measure the sequence by equating the money value of such parts of the two sides. By combining and recombining we may arrive at the least cost to a fixed result or the largest result of a fixed cost. Either of these, or the two in combination, makes the largest efficiency of the sequence under review.

5. To a limited extent this may be done with the quantities in their original units instead of their money equivalent. Thus ninety pounds of bituminous and anthracite coal mixed, per engine mile run may be high as compared with 135 pounds of bituminous per mile mile run. But such comparisons require a technical knowledge of the elements in combination, which can give to each unit its relative significance. This significance generally rests on its money equivalent as an ultimate basis. The practical use of such statistics is where the money value of the things or conditions discussed is not known accurately, but there is a general

notion of it. Thus seventy-five refrigerator cars and twenty-five flat cars, overhauled by a thousand days' labor, is better than twenty-five refrigerator cars and seventy flat cars repaired at eight hundred days' labor.

6. "Record statistics" are designed to place regular expenditures against their normal result, to which they bear a functional relation. By measuring the fluctuations in this relation we measure the efficiency of operation. For the most part the items are classified in their money values. Where, however, we use the original units, which require expert knowledge, as in the case just cited, we may call them technical statistics. Such would be yards of earth handled per man per day, coal per engine mile, etc. Not only are they highly technical because the significance of any ratios thus expressed can only be measured against some standard evolved from practice, but also because the effect of any single item may extend to remote results which only the trained eye will detect.

7. Therefore, proceeding by the foregoing methods of "pure" and "economic statistics" and of "record" and "technical statistics" we analyze a railroad according to the particular view point from which we begin. We are either the public or the operator. From the public nature of the business, the patrons are thought of as the public and the investor, employee and operator as the railroad. But the railroad is so large that in its operation it may affect a considerable class who are not patrons, such as contiguous property holders; also, the investor and employees are so large classes that their interests are largely public interests. If for only one road, public statistics serve for the investor as well as the public. But the public statistics are compiled from the operations of several roads. The investor whose interest is in a single property must have separate figures for his particular road. As his interest does not extend to ulti-

mate sociological questions, but only the immediate revenue-producing features of this particular property, the figures which he uses may be called financial statistics.

A Statistical Unit.

8. The classifications of observed things are as various as the points of view. When we have classified a lot of things we have resolved the field into a lot of groups or statistical units, each comprehending those things which for the greater part are affected by the same causes. Each such statistical unit is an organic thing as much as a plant. Within its limits its characteristic elements will play back and forth, now found here, now there. If wanting at this time they will surely appear at another time. We may no more subdivide it arbitrarily than we may cut off a man's hand and estimate what we have cut off as part of the original man in proportion of pounds avoirdupois.

9. For instance, we have a dining-car service extending over two roads and the expenses prorated on the basis of road miles. The statistician endeavors to alter the basis to the number of meals eaten. Now the diner was put on as one of the attractions to the through route, in the results of which both roads share according to their road mileage. Because my passenger happens to get to the table ten minutes before the car gets into the union shed at Atlanta, instead of twenty minutes afterwards, in no way affects my road's revenue, provided he were a through passenger.

10. Railroad statistics begin with net earnings or profits, and the field first breaks into the two grand divisions of gross earnings and gross expenses, including fixed charges. Earnings are the intake, expenses the outgo. Between the intake and the outgo is the whole machinery of operation, in which every other earning and every other expense are in some degree

involved. Unless some of this general machinery interpose between an earning and an expense, our gross intake is not an earning and our gross expense is not an expense. But only the net amount is a proper item for entry in the general earnings and expenses. And this net amount is either entered as an earning or an expense, according as it is normally a credit or a debit. Thus the rebate allowed on freight should be deducted from revenue and not charged to expense, but payments to a third party to secure business, as commissions, or involving any form of performance, as car mileage, are expenses. It is further an obvious principle that nothing should be deducted from earnings direct except what has once gone into earnings, nor from expenses except what has once gone into expenses. Therefore the ruling of the Interstate Commerce Classification bulletin, that the freight charges on misrouted freight over a foreign road should be deducted from earnings, is incorrect.

11. Earnings and expenses have their mutual effect on each other, and besides, each has its own class of causes that condition it. The figures that go into the expenses cannot be separated and charged direct to the particular part of the earning that profits by them. This is because the earnings or any part of them have been made possible through some direct causes, but especially through the great body of costs that cannot be separated. When there are any earnings for which we can find the full expense and separate them from the body of expense, they should never have been consolidated with the other expenses, but should have been applied direct to their earnings. Only the net amount should have gone into the general account. In other words, they are accounts where the debit and credit sides each tend to directly produce the other. Hence, each applies to extinguish the other. This is specially obvious in case of car mileage. Theoretically for

every car we receive from a connection we might have operated one of our own, which is earning on a foreign road.

12. These net amounts should be applied to the general expenses, and not the general earnings of the road, where they occur irregularly and are measurably within control of the management that is responsible for the expenses. Where they in part involve the earnings of fixed conditions that are a fixed cost to the road, as the earnings from repair work done at the shops and other special service performed for outside companies, not of the general nature of transportation, such part of the earnings as represents the reimbursement for direct outlay incurred should be applied to extinguish that outlay direct. But such part of the earnings as represents profit or use of tools and machinery, which is variously "loaded" on the charge as ten to twenty per cent., should be credited to the general earnings of the property. Trackage and excess baggage are such miscellaneous general earnings, because they are made possible through fixed costs which they do not directly incur or increase.

13. Therefore the great body of expenses are a distinct thing from the great body of earnings, and any effort to charge any particular earning with its expense entire, on the cost basis, is born of delusion. Earnings and expenses have no final relation to each other except in their grand totals for the road.

14. But if to the great body of earnings we cannot apply all the specific expenses in the regular accounts, it is highly desirable that we should be able to statistically apply such part of the charges for any particular service as are direct and had not otherwise been incurred. The importance of this should not be overlooked, for we may, in the absence of information, be doing parts of our business at a direct loss where we had thought we were earning a reasonable profit. This requires

statistics, because, in order to sift out estimated parts of direct costs we must resort to a whole series of observations to determine the average figures which we must use and the effect of the various conditions we wish to measure.

15. Having separated the gross cost from the gross earnings we take up each independently and study them by classifications special to each.

1. Such statistics have attempted to set up on the result side of the sequence a fixed quantity of result, which is assumed to be the dominating factor among the body of causes in determining their amount or cost. Against these, cost is measured. All the variation is located in the cause side. Statistics of this kind we have called "record statistics," to distinguish them from the more elastic form of "pure statistics," where neither side is taken as a fixed quantity, but each side has in it, and inseparable, a lot of other causes or effects which it is the nice work of the statistician to locate and approximately measure.

2. In elaborating record statistics by devising result units we must not essay too far. At best we can never devise a result unit that shall be an absolute and infallible standard under all conditions by which to measure a particular expense. The extremely intricate interrelation of the parts, their dependence on one another, make it most difficult to disengage one sequence from another. We fall back upon the fact that there is a certain permanence of types of doing things. One kind of work is carried forward to a certain point, and then another comes forward and carries on the product from that point. These types are evolved in usage, and therefore are subject to gradual change. Thus, for instance, our train mile or our car mile has year by year come to stand for a greater and greater ton mile movement.

3. There is also a further variation in types, by the changing methods of doing the same thing. This

must from time to time greatly alter the conditions on which our system of record was first worked out. Thus we may have replaced our wooden viaduct with one of steel or stone. For these there would be comparatively no maintenance charges. Or we may throw our yard switches by an interlocking plant where we formerly employed a yard force; or we may manufacture our car wheels where we formerly bought them.

4. We begin with the great mass of expense which is cause, as a condition precedent, to our gross earnings. We split it up into its causes on the theory of their efficiency to produce these gross earnings. Throughout, in classifying an expense, we keep in mind the purpose for which it is incurred, as related to the entire scheme of railroad operations. Grouping by any local or chance description would make our information irrelevant and convey no significance. As, for instance, the section foreman had occasion to bury a dead tramp who had been killed by a passing train while trespassing, and the cost of digging the grave was charged by him to "ditching," maintenance of way, while his own time as foreman supervising the interment he soberly charged to "watching," maintenance of way.

5. The first thing we have in mind in operating a railroad is revenue. And all outlay is classified as expenditure for this result. Therefore, all expenditures that are not within the option and control of the management within an earning period, and so applicable, as direct charges to earnings of a certain period, are not included. Such would be taxes and interest on first cost of the general and inoperable features of the property. In time it is noted that certain kinds of expenditure are of regular recurrence, so much so that they become subordinate objects to be attained, fixed results to be accomplished, quite as much as the revenue itself, because they are known to be absolutely

essential to it. Next it will be noticed that certain of the expenses or outlays will produce their full result within one earning period or even less time, whereas others extend over indefinite earning periods. Then we separate the outlays into such as are immediately consumed, and such as extend to several earning periods. We will find that some of the outlays whose effects extend over one earning period last indefinitely, while others only last for two or three years without renewal or further outlay. These further outlays we will consider as maintenance of the first standard created. They will be considered, not as outlays to add to an existing standard, but to offset its wear and deterioration within a given period. The first standard thereby preserved intact is not thought of as incurring any further outlay except the annual interest charge on the funded first cost at the ruling rates of expectation of annual increment of fixed investment.

6. Thus it will be seen that the line between those outlays that are assumed to be preserved intact over several earning periods by the application of subsequent smaller outlays considered maintenance, and those first outlays that are consumed within a single earning period, is quite arbitrary. However, in absence of any fixed rule, it is quite safe to say that the determining condition is the proportion that the renewal bears to first outlay in any one earning period. This, of course, varies with the nature of the thing thus produced. At the outset it is assumed that outlays which do not produce definite tangible things, but are only to set up new conditions, as the forming of a traffic agreement, the developing of a new market, are consumed at once and their effect does not extend indefinitely. Therefore these are not charged to fixed investment. The assumption is not always correct, but it is safe as a general rule, and for this reason strictly adhered to. Usage goes on to determine for specific

things whether they shall be considered fixed outlay or current expense. But it is obvious that where the renewal exceeds fifty per cent. of first outlay in any one earning period, or where the nature of the renewal is not to preserve intact the first thing, but to extend its effect as far as possible on a lowering standard, the first outlay could not be properly considered a fixed investment.

7. As the chain of sequences, by which the whole process of producing revenue by performing the service of railroad transportation, crystallizes into fixed types each type in the chain becomes a product to be made. It comes to have a value set upon it in view of the ultimate value it is in line to produce. Our organization of the work shapes itself around these types on a general plan, and we classify our costs with reference to them. As conditions continue to settle and organization of work goes on, where we formerly separated in our minds the results produced by a certain geographical distribution, we now look at the results as a whole, made up of processes or kinds of work. Several different kinds of work are necessary to make each thing produced.

8. The work is organized by classes and not by geographical units. We have a bridge and building department, a mechanical department, a roadway department, a traffic department, a transportation department, etc. Each of these department serves the general use of all the road, and not of any one part. Although the different parts serve different kinds of uses, it is assumed that they are all permanent and inseparable features of the whole. Therefore, work of one general description is all charged to the same general account, regardless to what part of the whole it may be applied. Thus the bridge and building department paints a shop or a roundhouse or a fuel station and charges the cost to the same account as painting a

depot. Again, the roadmaster lines up the track and replaces the ties of the track in the erecting shop or on the repair track of the shop yard, and charges the expense to the same account as he does in case of similar work on the roadway itself.

9. When, in the course of development, one by one new types or parts of the railroad operations are evolved and set up as fixed conditions, each department extends to do for them the service for which it is responsible, and charges the cost to the general account that is descriptive of that class of work.

10. The cost that is charged is the direct cost, the specific current expense incurred. It is not the fixed and undistributable costs of the work. As the organization progresses each department comes to be an establishment having a plant and fixed costs. These fixed costs cannot be applied to the work done except by arbitrarily prorating them. Such are the costs of superintendence, the maintenance of tools, machinery, shops, general office buildings, taxes on property special to each department, and the interest on first cost. In fact, as before noted, in case of the track in the roundhouse, these have so long been assumed to be constant and essential means to given results, as maintenance of rolling stock, etc., that they have long ago ceased to be strictly identified with the particular part of operation for which they have been built. They have become fixed parts of the general property and the cost of their maintenance goes into the general maintenance account of the road. While this is the principle on which the expense classification is built it is open to question if it is not carried to absurd limits. The essential condition, in making use of it, is that the subordinate type set up, be a permanent and necessary feature of the general operations.

11. With the organization thus shaped and the accounts arranged to conform, our statistics must be

devised to show whether our operation is efficient or inefficient, and to locate the inefficiency. We must at the outset discard all notion of measuring the efficiency of any given stage of the work in the dollars which it ultimately earns to the road. Our study must be comparative between different times and places.

12. In order to judge whether a cost is excessive or moderate we must clearly comprehend the nature of an act and look upon our figures as mere coefficients of the work of departments and individuals. Every act is simply the assembling of a lot of causes which are costs, and out of their combination producing a lot of results, one or more of which is the result desired. The causes and effects are always equal. To measure the efficiency of any sequence we may either place the efficient result against the non-efficient result or the efficient result against the entire body of causes, which is the gross cost. Or again we may place the non-efficient result against the entire body of causes or the efficient against the non-efficient result.

13. Our analysis proceeds from each result back to the causes which produce it, and then from each of these causes, in turn, as themselves results of anterior causes. For the most part, our form of analysis is to place several causes against one efficient result. The several causes are reduced to one figure by converting them to their money equivalent, which is their cost. But there is a special form of statistics, which we have arbitrarily designated technical statistics, where we place one cause only against one result. The particular cause selected we assume to be the dominant cause and therefore an index to the general body of causes. An instance would be the tons per car or cars per train.

14. A result is described by kind and degree or quantity. By the stages so far outlined we have divided

the expenses into different kinds and in practice once every thirty days we run a line through our figures. Assuming that time is safe as a common measure of the body of causes applied and of results realized, we take the time period as describing degree. We conclude that we are thus identifying our causes and our results and place against the returns of that period the specific causes that have brought it about. The result is far from what is to be desired, for our assumption is incorrect. Practically, railroad men have found the necessity of better accuracy. They have devised intermediate units of results, such as ton miles, car miles, train miles, number of ties laid, yards of ballast placed, cars overhauled, coaches cleaned, etc. It is along this line that the most practical statistics are worked out.

EARNINGS CLASSIFICATION.

1. The traffic man has wanted the business. He found that different sorts of traffic would not move at the same rate, so he divided it into classes in order to stimulate it by offering different concessions to each class. In his classification, expense of handling, distance, and insurance theoretically entered as factors. But, practically, insurance and expense of handling entered only in such a crude way that it may almost be said that they did not enter at all. Even distance itself was very much disregarded. The business was classified by groups of commodities and by markets and producing centers on certain large lines of movement. It was also grouped by lines of movement having reference to existing industrial organization and even social organization, as in the case of clergy rates, etc. The theory of the classification is that all the articles in each class involve the same cost to handle and the service performed is of equal value to them all. Therefore they affect alike the expenses and they will respond as a unit to changes in rate. The whole range of articles is divided into six to fourteen regular classes. Certain special articles peculiar to the traffic of a particular road are withdrawn and treated separately. The adjustments to meet the special conditions of different markets and different producing centers are in this way brought to bear on the different conditions of traffic which they are designed to affect.

2. While this is true in explanation of a railroad classification in its theory, statistics are seldom or never called into play to enumerate the volume of business and the earnings under each of these classes. In-

stead, railroads are accustomed to use the Interstate Commerce Classification of commodities to which they add variously a dozen to a score or more of other articles which it may be specially desirable to watch on the particular road compiling the figures. These commodities represent the great classes of manufactures, crude products or agricultural products, and merchandise. They tend to show, in a very general way, the volume of movement of manufactured, agricultural, forest, and mine products and the general commercial movement from the markets to the consumer. The merchandise account is not intended to be any particular article or limited class of articles, but all articles in their movement from the market or point of distribution to the consumer. Such statistics do not bring out the expensiveness or profit of different kinds of traffic. They therefore carry only a most remote practical significance to the railroad.

3. A statistical classification of earnings for practical use of a railroad should divide the earnings into groups, within which the same causes will prevail for raising and lowering the rate, and throughout which the effect of such changes will be the same. Each unit that comes under the description of such a group is an earning unit. It is a device for getting back a gross outlay in a multitude of small and different payments. It must therefore be a definite thing and have a definite relation to expense, because the total of such units is the divisor of a dividend which is the gross expense, to arrive at a rate of charge which is the quotient. The gross expense is roughly composed of two parts; one is the direct cost of each unit of service, the other has no relation to specific units.

4. The earning unit, whatever it be, should be devised out of the elements of cost so far as to refund the direct expenses, either by taking them at their actual figures or including their erratic appearance,

within the range of the account to be refunded at an average figure. This is especially obvious when the gross expense to be refunded belongs to different railroads. Unless the earning unit is a unit of cost, the apportionment of gross earnings on this as a basis may give to one railroad the reward for service performed by another.

5. After the direct expense has been paid back, it is a matter of indifference to the railroad what may be the basis for getting back the fixed charges, so long as it rests on fairly stable conditions. It is entirely conceivable that a passenger tariff could be constructed, making different rates to different people, according as their hair is black or gray or red or flaxen, just as it now makes distinction between clergy and laity or between children and adults. It is only necessary that the gross expense be not materially affected and that the original proportion of each color of hair remain the same. The basis is generally a thing of long evolution that may be traced back to the costs of more primitive methods of transportation, in which direct costs constituted almost the entire expense. For the railroad, one basis had originally served as well as another. But after the general economic conditions have been set up on a particular basis, any change may do sweeping violence to values.

6. Where the railroad at the outset has been disinterested and began by charging the general expenses arbitrarily, the public have been vitally interested. From time to time, not in consciously following any defined principle, but here and there as the practical exigency has suggested, they have brought pressure to bear for special concessions to particular conditions, until a first arbitrary rate has given place to a great variety of rates.

7. After defraying the direct costs of each particular service, the different rates apportion to each serv-

ice the general expenses in the proportion which each is able to bear. A direct cost we may charge directly, but when we have passed over into the field of the indirect costs that remain, there is no possible way to charge the cost except on the basis of the value of the service rendered.

Instead of being a makeshift this is simply a continuation of the first principle of charging a direct cost on the basis of the units of cost, because at that theoretical point where a cost is converted to a specific use the cost and the use are equal. When direct cost ceases to exist, it is only natural to charge the expense on the basis of use or value. No other equitable principle is possible. If this is discrimination, it is only the discrimination of equity, which distinguishes between different conditions in the application of a general rule. The so-called "natural rate," constructed rigidly out of weight and distance and terminal expense, is most unnatural, artificial, and unjust.

8. In dividing up a traffic into groups within which a service performed at a given expense shall be of equal value to all in that group, it is only necessary that there be no discrimination between individuals, or violence done to existing values. If one passenger rides on the trolley car five blocks and another five miles, at the same cost, it is no discrimination between individuals, because the direct expense of carrying each passenger was the same. Both were equally entitled to the full ride, and further, both, in a long course of time, might find equal use for it. But if the longer ride were fifty or a hundred instead of five miles, it would under most conditions belong to a different class of uses from the ride of five blocks, and would go into another earning group. It is on this principle that the Austrian zone system of passenger tariffs is built. The direct cost of handling the individual passenger is practically so small a part of the entire expense of passenger trans-

portation that it may be largely unconsidered. In Switzerland a further step has been taken, and passenger transportation is sold for time periods irrespective of distance traveled. Unless this disarranges the direct expenses of operation, practically the only thing to be considered is the value of the service to the patrons. Distances there are so short that one man cannot well get a greater use out of the service than another on this basis.

9. On the mistaken assumption that the passenger mile for passenger business and the ton mile for freight business is the universal unit of cost, and that difference in the value of service is accommodated by different rates for a few different classes of passenger travel and a classification of commodities, there has been great insistence that tariffs be based on distance and weight. But by ignoring terminal expense and density of traffic, this falls short of its purpose as a basis of charging on the basis of actual cost. The first idea has slowly given way to the principle that no greater charge shall be made for a less haul in the same direction, and finally the true principle has been obscurely acknowledged by the saving clause, "the same service, under the same conditions."

The question What shall be the basis for a rate? offers a favorite field for the speculation and ingenious plans of social reformers of every degree. The postage system of freight tariffs has been soberly urged and unaccountably received some serious consideration.

WORKING TOOLS FOR THE STATISTICIAN.

1. The technique of statistics is only secondary in importance to a proper knowledge of statistical method for attaining any practical results. Tradition still reigns supreme in the accounting departments of many roads. Railroads that lay out thousands of dollars in experimental locomotives, mechanical devices, and new machinery for their shops, allow their accounting shops to go on in inexcusable ignorance of the latest and best that science and invention can do for them. Perhaps to this, as the largest single cause, can be attributed the inadequacy of most of the statistics furnished on railroads. They are so late, often so unreliable, and generally so inelastic in form that they have little practical value in operating a property.

2. No statistical office should be without a slide rule any more than a carpenter shop without a square. Yet it is doubtful if it can be found in a dozen railway offices in the country. The best form, for general use, is the Thacher spiral slide rule, which has long been in general use among engineers. Adding machines can be used profitably in certain parts of the work, as taking off daily earnings or picking out items from a miscellaneous account. There are other places where they hinder rather than assist. Because their use at some points is injudicious should not debar them from those uses where they are most efficient.

3. A hitherto unmeasured factor in solving the technical difficulties of the statistician, is the principle of using cards.

The last censuses of the United States, Canada, Aus-

tria, and Russia were handled with remarkable results by the use of cards and the Hollerith Electric Tabulating Machine. There has recently been worked out an application of this system to railway freight accounts and statistics. The freight accounts are handled in this way at a less cost than by the manual method, and the statistics are so much by-product. It is possible to make any elaborations of the ton mile desired, at a merely nominal cost. Ton miles classified by commodities or class of freight up to this time could only be made at a prohibitive expense.

4. The statistician should be supplied with the interstate and State commerce reports, Poor's Manual, the annual reports of his own road and of other roads operating in the same territory, for several years. He should have by him a chart of the normal working "averages" on regular expenses and features of operation, for the different divisions of his road. He should use freely, where they avail, physical formulæ from the testing laboratory. He should acquire familiarity and facility in handling general industrial, commercial, and financial statistics, in order to use them where they apply in explaining working conditions of the railroad property.

Where working conditions are permanently bad, he may introduce arbitraries into his statistical comparisons, to offset the fixed conditions. These will be the red flags on his working charts. From time to time he will make special investigations to see how far they may be removed or mitigated.

Cartography.

5. Cartography can sometimes be used mose effectively in popular statistics, where the effort is to convey with emphasis a particular idea. We can use them to represent proportion, and so convey graphically notion of relative significance.

6. Perhaps the simplest form is the geometric figure, either by placing two like figures before the eye, relatively proportioned according to the facts to be shown, or dividing up one figure in the several proportions to be represented. The triangle, square, or other quadrilateral involves measurements by two dimensions, while in case of a circle, where a single figure is used, we simply measure the proportions on a circumference.

7. Sometimes the popular effect of a comparison is greatly heightened if the quantities be represented by drawings of the object of whose attribute they are a measure. Thus the relative weight of a passenger train at two different periods would be most effectively shown by two drawings of the same train proportioned to each other as the respective weights. Or the decline in freight rates on a barrel of flour from Chicago to New York would be emphasized by representations of two barrels having the relative size of the rates to be compared. A recent magazine article on the relative strength of the powers, for military purposes, was given ten-fold emphasis in the popular mind by representing each country by its characteristic figure of John Bull, Uncle Sam, etc., all the figures in each group being drawn in the relative sizes of the quantities for which they were made to stand.

8. But comparisons by use of geometric or other figures are generally of the simplest kind, conveying notion of quantitative relations of the things or qualities observed, but not of the causal relations that may exist among them. This is because in order to locate causal relations we must see the factors in various combinations, and a single figure divided up to several parts, or a group of proportioned figures, represent only one combination. In order to have several combinations, the mind must pass from one figure to another by steps instead of connected transitions, and this is difficult if there are several factors to the combina-

tion. In order to show causal relations we should for most cases have the full chart, and "plot the curves," as the engineer terms it, of the quantities observed.

9. At times it is desirable to connect relative proportion of things with geographical location, so that the mind may pass over without thought to general causes. Thus the traffic density of a road is shown very handsomely in French statistics by thickening the line on the map in the proportion of traffic carried.

10. After size and outline, we may use different colors or shading, in extension of the first principle.

11. The arrangement of a series of geometrical figures, when they are proportioned to show the measure of some one thing at different observations, on the basis of some common scale, passes by easy stages to a series of oblongs placed side by side, having significance in only one dimension. These give way in

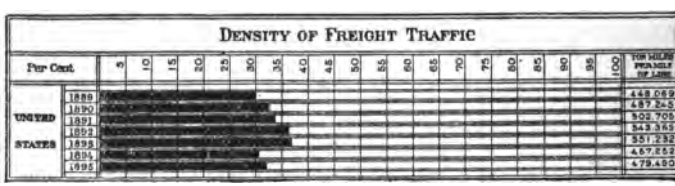


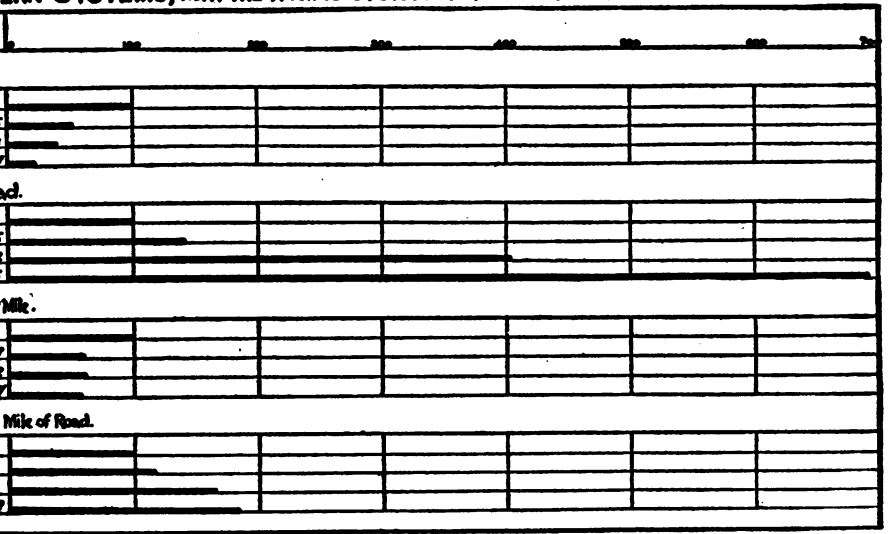
CHART A.

time to mere heavy black lines. An example is Chart A. When these lines are arranged progressively, along some common base line, in the chronological order of the observations or after any other order of progressive development, if we connect the tips of their free ends with a continuous line, we have the form of the full chart. It is important that there be a progressive development, or otherwise the "curve" we have plotted has no significance. At a recent international Railway Congress, among the papers presented was included a chart of weight of engines of different roads, arranged in some order, al-

CHART B.

COMPARATIVE AVERAGE RAILWAY RATES, IN GOLD, AND VOLUME OF TRAFFIC, 1873 AND 1892. OF TEN PRINCIPAL EASTERN SYSTEMS, WITH THE PACIFIC SYSTEM OF THE SOUTHERN PACIFIC COMPANY.

	Year.	Amount.	Per cent.
Freight Rates. Average per ton per Mile.			
Pacific System.	1873	Cents 3.51	100.
" "	1892	" 1.81	51.6
Eastern Systems	1873	" 1.80	99.3
" "	1892	" .76	21.4
Freight Traffic. Average tons per Mile of Road.			
Pacific System	1873	166,488	100.
" "	1892	235,698	141.6
Eastern System	1873	704,890	423.2
" "	1892	1,152,626	692.6
Passenger Rates. Average per passenger per Mile.			
Pacific System.	1873	Cents 3.58	100.
" "	1892	" 2.14	60.8
Eastern Systems	1873	" 3.19	62.2
" "	1892	" 2.03	57.7
Passenger Traffic. Average passengers per Mile of Road.			
Pacific System	1873	95,931	100.
" "	1892	111,903	116.
Eastern Systems	1873	1,58,258	166.
" "	1892	176,885	183.8



Eastern Systems include: Boston and Albany; N.Y. N.H. and Hartford; N.Y. Cent. and H. River; Lake Shore and M.S.; Penna. R.R., Pitts. Ft.W. and Chicago; Wabash; Louisville and Nashville; Chi. and No.W.; Illinois Cent. Road operated in 1892, 13,463 miles.

phabetical or otherwise, as they happened to come, and a "curve" was soberly run from one to the next, as if it was tracing some law of development.

12. On a full chart we can plot as many "curves" as we have room, and so show to the glance the varying relations of the quantities they represent. The different lines should be of different color or distinguished by different markings, so that the eye will select any one without effort, from all the rest, across the entire chart, and thus will be conveyed an impression of its general character. When we wish to plot the detail of a general total, sometimes instead of using a common base line we may plot the first on the base line and rudely suppose each detail below it as its base line, and in this way build up to the curve that represents the sum of the whole. Chart C is an example of this. By filling in the intervening spaces with different-colored inks we have produced a very striking general effect.

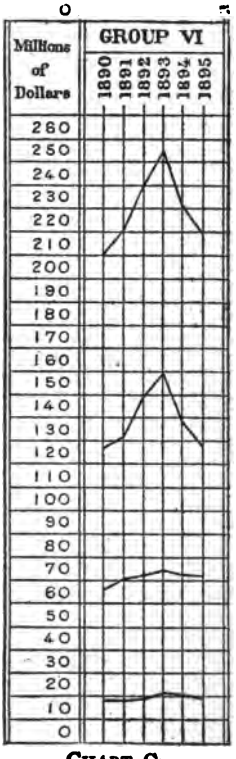


CHART C.

13. The charts given herewith were prepared by Mr. Gerret L. Lansing, late comptroller of the Southern Pacific, in connection with his very able monograph "The Right of the Railroad to Reasonable Rates," which is one of the best pieces of statistical work that has gone out of a railway auditor's office. The charts are an admirable illustration of some of the principles just enumerated.

WHAT IS COST?

1. Below is given the formula proposed by a large road for getting at the cost of their freight per ton mile:

SCHEDULE SHOWING GROSS COST OF TRANSPORTATION PER CAR AND PER TON OF FREIGHT, TAKING AS A BASIS THE ENTIRE EXPENSES OF THE LINE DEBITABLE TO FREIGHT SERVICE, FOR THE YEAR.

(*Approximated.*)

	Cost in Cents. Per Car per Mile.	Per Ton per Mile.
Gross average cost of hauling 1 freight car only per mile,	2¼	
Gross average cost of hauling 1 car with 1 ton of freight per mile,	2⅓	2⅓
Gross average cost of hauling 1 car with 2 tons of freight per mile,	2¾	1¼
Gross average cost of hauling 1 car with 3 tons of freight per mile,	3	1
Gross average cost of hauling 1 car with 4 tons of freight per mile,	3¼	
Gross average cost of hauling 1 car with 5 tons of freight per mile,	3½	0.70
Gross average cost of hauling 1 car with 6 tons of freight per mile,	3¾	
Gross average cost of hauling 1 car with 7 tons of freight per mile,	4	
Gross average cost of hauling 1 car with 8 tons of freight per mile,	4¼	0.53
Gross average cost of hauling 1 car with 9 tons of freight per mile,	4⅓	
Gross average cost of hauling 1 car with 10 tons of freight per mile,	4¾	0.4712
Gross average cost of hauling 1 car with 11 tons of freight per mile,	5	
Gross average cost (actual average) of hauling 1 car with 11.29 tons of freight per mile,	5.152	0.4563
Gross average cost of hauling 1 car with 12 tons of freight per mile,	5¼	
Gross average cost of hauling 1 car with 13 tons of freight per mile,	5½	
Gross average cost of hauling 1 car with 14 tons of freight per mile,	5¾	

	Cost in Cents. Per Car per Mile	Per Ton per Mile.
Gross average cost of hauling 1 car with 15 tons of freight per mile,	6	0.40
Gross average cost of hauling 1 car with 16 tons of freight per mile,	6¼	
Gross average cost of hauling 1 car with 17 tons of freight per mile,	6½	
Gross average cost of hauling 1 car with 18 tons of freight per mile,	6¾	
Gross average cost of hauling 1 car with 19 tons of freight per mile,	7	
Gross average cost of hauling 1 car with 20 tons of freight per mile,	7¼	0.36
Gross average cost of hauling 1 car with 21 tons of freight per mile,	7½	
Gross average cost of hauling 1 car with 22 tons of freight per mile,	7¾	
Gross average cost of hauling 1 car with 23 tons of freight per mile,	8	
Gross average cost of hauling 1 car with 24 tons of freight per mile,	8¼	
Gross average cost of hauling 1 car with 25 tons of freight per mile,	8½	0.34
Gross average cost of hauling 1 car with 26 tons of freight per mile,	8¾	
Gross average cost of hauling 1 car with 27 tons of freight per mile,	9	
Gross average cost of hauling 1 car with 28 tons of freight per mile,	9¼	
Gross average cost of hauling 1 car with 29 tons of freight per mile,	9½	
Gross average cost of hauling 1 car with 30 tons of freight per mile,	9¾	0.3212

The above includes cost of returning empty cars, but when foreign cars are used the rate per mile paid for their use for round trip should be added to these rates.

As the average tare of refrigerator cars is over 18 tons, compared with 11 tons for box cars, the cost of hauling one refrigerator per mile (empty) is about 4 cents, with ¼ cent added for each ton of freight carried, together with the full amount paid for use of car.

MEMORANDUM OF BASIS OF CALCULATION FOR COST OF HAULING PER CAR AND PER TON FOR YEAR 1895.

Total traffic earning freight car miles,	Loaded,	155,716,043
	Empty,	54,138,855
	Total,	209,854,898
Total tonnage mileage (tons one mile),		1,758,023,833
Average load moved per loaded car,		11.29 tons

Total expense debitable to freight service, including departmental and general expenses,	$8,022,725
Average cost of haulage per loaded car per mile, with average load of 11.29 tons,	5.152c
Average cost of transportation per ton per mile,	0.45635c
Average weight of freight carried per loaded car,	11.29 tons
Average weight of one freight car,	11.21 "
Average gross weight carried at a cost of 5.15½c per mile,	22.50
On above basis the cost of haulage per mile for the car only is,	2.567c (or 2½c)
And for the average load of freight, exclusive of car,	2.585c
Total cost of car and freight per mile as above,	5.152c
The average cost, therefore, of hauling one ton in a car on above basis, taking in all expenses, as under:	
For the car only per mile,	2.567c
And if 11 29 tons cost 2.585c per mile, one ton will cost,	0.229c
	2.796c
And the cost of each additional ton in the car will be,	0.23c

(Empty car miles are treated as an item of expense only.)

NOTE.—As an approximation, and for convenience of working out rates per car and per ton, on statement "A" the cost of the car only is set down at 2½c, and per ton at 0.25c per mile.

2. ANALYSIS OF EXPENDITURE CHARGEABLE TO FREIGHT SERVICE, ALSO COST PER TON PER MILE FOR EACH ITEM FOR THE YEAR 1895.

		Average Cost per Ton per Mile.
Motive power expenses connected with freight traffic,	$2,570,939	0.15193c
Car department expenses connected with freight traffic,	825,856	0.04698c
Transportation expenses connected with freight traffic,	2,599,654	0.14787c
	$6,096,449	0.34678c
Permanent way expenses charged to freight traffic,	1,391,432	0.07915c
	$7,487,881	0.42583c

			Average Cost per Ton per Mile.
General charges charged to freight traffic, . . .	$128.456		
Miscellaneous expenses (including rent of rolling stock) charged to freight traffic,	406,388	$534,844	0.03042c
Total expenses chargeable to freight traffic, ...		$8,022,725	
Average cost of transportation per ton per mile for 1895, ...			0.45635c

AVERAGE LOAD MOVED PER LOADED CAR, AND COST PER TON PER MILE, ETC., FOR THREE (3) YEARS.

YEAR.	Tons Moved per Loaded Car.	Cost of Hauling Car only per Mile.	Cost of Net Freight in Average Load per Mile.	Total Cost per Loaded Car per Mile.	Average Cost per Ton per Mile.
1893.....	10.70	2.612c	2.551c	5.163c	0.4815c
1894.....	10.65	2.535c	2.421c	4.956c	0.46519c
1895.....	11.29	2.567c	2.585c	5.152c	0.45635c

MEMORANDUM SHOWING GROSS AVERAGE COST OF TRANSPORTATION FOR FREIGHT TRAIN MILE, DIVIDED BETWEEN DEADWEIGHT OF TRAIN AND NET FREIGHT CARRIED FOR THE YEAR 1895, CORROBORATIVE OF STATEMENTS "A" AND "B."

The freight train mileage for the year was . .	10,897,307
And the loaded freight car miles, ...	155,716,048
The average number of loaded cars per train was,	14.29
The average number of tons carried per loaded car was, ...	11.29 tons
The average cost of transportation per freight train mile, including all expenses, was, . . .	73.62c
The analysis of cost on basis of statements "A" and "B" is as follows:	
Cost of hauling deadweight of cars per train of 14.29 cars at 2.567c per car per mile, . .	36.68c
Cost of hauling 11.29 tons per car in 14.29 cars at 2.585c per car per mile, ...	36.94c
Total cost per freight train mile as above, . .	73.62c

3. It is very elaborately and carefully worked out, for it is intended to be a guide in rate-making. But let us only disturb operating conditions by a larger car or heavier train, or let us get on one side or the other of the balance of traffic movement, or let that balance of movement be disturbed or the relative proportion of our various grades of traffic be disturbed by general commercial causes outside of control, or let us deliberately set up a lot of causes by changing the rates, and our house of cards falls to the ground. And, further, who will defend the reasoning by which the undistributed expenses are apportioned to passenger and freight services on the basis of train miles? Assuming that this basis is right, the formulæ that we have gotten are exact measures of past conditions. But for the future they are only valuable so far as those conditions exactly repeat themselves, or continue in their original proportion. The traffic man, even more than the operating man, is dealing with highly elastic conditions. He is dealing with an organic thing that may expand and grow or contract and wither. The very thing which most largely determines the volume of business and so the cost per unit, which is the rate, is thus held as rigidly to a formula evolved out of other and past conditions as some Chinese mandarin.

4. The manager is assailed from a hundred quarters with the question, What is the cost of this specific thing or that specific part of operation—of the mail service, of the express service, of a certain passenger train or an added coach.

5. At the point where a thing is appropriated to a specific use, its cost and its value in its new use are equal, except for the margin of profit that serves as stimulus for the undertaking. At that point the thing contracts its field of general use, and so of general demand, to the scope of this particular use. If the process of its conversion to this new use were instant,

the cost would fix the price; but if the process is a long one, the cost value is held in suspense and exposed to all the outside play of supply and demand, until it emerges in the new product. This is the commercial venture of the undertaking.

6. In free competition, of numberless small competitors, a myriad causes, playing now on the demand and now on the supply, are incessantly active, and the resulting outcome of market price is within no single control. But we may regulate it if we can control the supply while a demand exists, or if we can regulate the demand while the supply exists. Power to regulate the supply is monopoly. But it can only regulate the supply of a specific thing and so control the price within the limits of the effective demand for that thing. Any monopoly is always in competition with some other line of supply that can at some point become a substitute for the commodity it supplies.

7. A railroad is from its nature a monopoly. Competition, although it exists and most violently, is anomalous to the nature of a railroad. However great may be the competition, yet towards the great body of its traffic it may be said to bear the relation in various degrees, of a monopoly. A monopoly is very for from being a wholly bad thing. The interests of a wise monopoly must be identical with the largest prosperity of the community served. Individual rights are still as sacred, but the method of their determination is different. What men fought for and settled by the anarchy of unregulated competition can better be settled by the principles of equity. A dawning appreciation of the magnitude, public moment, and far-reaching consequences of railroad operation has given emphasis to this, and the reasoning more and more has turned to the problem of what is theoretical cost.

8. The problem is to equitably apportion among the interests involved the expense, risks, and profits of

the service in that measure to each which shall be just, from the standpoint of its special conditions. It begins first with a statement of what is the direct, actual, physical cost incurred by each interest. It passes over into the question of the value of the service performed which shall offer basis for apportionment of the undistributable expense. When the question of compensation to the railroad for mail service is under discussion, the necessity for some principles on which to get the cost of service is obvious, because competition does not enter as a factor. It is far from any man to say that he can perfectly work out artificially the play and counter play of forces and conflict of interests to a finished product that will be the same as the market price evolved in the natural course of the laws of trade. But much can be done by candid reasoning that may go a long ways towards relieving conflict that can lead to little good. If it is true that we cannot show what is cost, we may at least show what it is not.

9. A thing costs what we give up to get it. This is not necessarily what we exchanged for it when we bought it, but it may be what we might have gotten for it subsequently, which we sacrificed in order to hold it to the use finally made of it. Thus the cost of running a particular train may not be, only the train service and train expense of that train, but the revenue we might have had otherwise, which we sacrificed by running it for this specific purpose. It is true that these other uses are generally very subordinate to the regular use, but in discussions of actual costs, wherever such secondary uses have a value exceeding the first money cost, they properly enter, because a thing costs us at any time the greatest value we give up to get it.

10. However, it must be definitely sacrificed. An added coach for a special use in a passenger train is not necessarily worth the average earnings of the other cars in that train unless by putting it on we were com-

pelled to take off a coach that had carried passengers who were left behind. Nor even yet need it be the loss of revenue by that coach, if the train movement capacity of our track is not exhausted, but only the cost of the second section which would be necessary to run it.

11. A thing costs only what we give up to get it, and we cannot give up what we do not have. What we surrender at any time is not any past cost of a thing but an instant, present use or discounted value of a future use. It is only at a point of option therefore, between two alternatives that we give up anything and the thing we give up is that alternative we hold at less value. Hence in getting at any figures of cost we must break up our expense into such separable parts as can be found. Only at the points of separation have we exercised any option whether we would incur an expense or not. It is only where a highway forks that we exercise any choice of the road we travel. Such points of forking are only occasional. If we have put on six coaches instead of five, we have definitely sacrificed the amount of the added outlay for running that sixth coach. But by no possible legerdemain can we make a sacrifice of the cost of running half a coach. It is the common error to say that this is half the cost of running the whole coach. In this sort of reasoning lies much of the fallacy which has brought the effort to get at cost into contempt.

12. In dividing expense into separable parts, our first obvious division is into the costs of physically and commercially separate things, as one locomotive, one tie, one rail length. Next, and not so obviously, our separable parts are divisible into commercial groups or classes of physically separate things. An Eastern road at one time had a particular passenger train of twelve coaches, which was a working load for the locomotive in use. When it happened that there were thirteen

coaches, it became necessary to make up a second section. The thirteenth coach, which was a mail car, directly necessitated the expense of the second section. Either we must charge the entire expense of the new section to this mail car or we must raise the proportional expense of all the other cars to include the cost of running the two sections. The latter method is correct, because the added car is, with all the other cars, only one of the contributory causes for the expense. It was entirely accidental that this particular car was the thirteenth. This risk of being the thirteenth car was common to all and should be borne by all. But if the thirteenth coach were always the same car, and were very occasional, it could hardly be said to be of the same class as the other cars, constituting with them one of the standing potential causes for running that train. Therefore it would not enter with them as an equal unit for sharing the cost. It is an extraordinary cause and should bear the extraordinary expense.

13. After the separability of things and groups of things, there is a separability in the expense of using a thing. A single use of a thing and an extended use of a thing will bear different relations to ordinary current repair expense, overhauling and renewal expense, expense of annual taxes, and finally annual rental or depreciation and interest on first cost. It is on this theory that the operating expenses account of the railroad is separated from the income account. In this way we find forms of operation that are partially separate, as the dining car service on some roads which charge current running expenses to a dining car account, but the maintenance of the cars to the general operation account of the road and the interest on the cost of the cars to general income account.

14. So soon as the manager sets out to determine cost, he finds that it is a very relative thing. He

already uses the terms direct cost, indirect cost, current cost, fixed charge, without much precision. The cost he wants is the cost per unit, and he finds it is made up in the following way:

1. The direct, entire cost of a thing.

2. The direct part cost, as the added cost for coal for the added car of a train.

3. The proportional part of a gross cost.

(*a*) Where the number of units by which it is divided remains fixed, as the monthly proportion of an annual rental.

(*b*) Where the number of units by which it is divided is variable, as the number of passengers per train.

15. Direct cost is the cost which is incurred for a specific thing, and which would not have been incurred except for that specific thing. It is of course first, cash; next it is coal or other supplies or material or the current wear of a thing as an engineer or a car, or the use or rental of a thing when there was any other use which it displaced. Each mile run of a particular engine, when there are any considerable number of miles taken together, appreciably affects the cash outlay for repairs. But the wear of rail by a single train's mileage is inappreciable as affecting the negotiable value of that rail, because the actual negotiable value is so far below the cost of it when new.

16. The direct entire cost or direct part cost of a thing is comparatively simple. But the proportional cost of a thing carries into great difficulties, because a proportional cost is a theoretical and not an actual physical thing. Yet this may amount to anywhere from 70 per cent. to 95 per cent. or even more of what is held to be the cost of a specific railroad service. A train hauls seventy passengers. There is a natural reasoning by which we consider that the cost to each of them is 1-70th of the whole cost. But from this alone

it does not follow that the cost of hauling any particular passenger was 1-70th the whole expense. This is only true when each passenger with every other had equal need and equally demanded that train. Then the expense was incurred by them equally. No one could be charged less than any other because no one enjoyed a greater use which would enable him to bear the amount that another had been relieved, and hence the cost to each was 1-70th. The proportional cost to each; therefore, does not depend on the amount of any specific cost, for none exists, but on the relation of each use served to every other use served.

17. Direct cost is had largely by measuring physical things. It is a mere truism to say that the direct cost of train movement depends on weight, speed, distance, grades, alignment, stopping and starting, etc. Yet the schedule for railway mail service compensation ignores entirely the element of speed, and pays only for live weight, leaving the uncertain proportion of dead weight to live weight, to the discretion of the postal authorities, who may put on a postal car where they deem fit. It makes no concessions for extraordinary costs of operation peculiar to special territories, because of grades or distance to the coal field which make the cost of engine fuel excessive. It imposes special service outside of strictly mail transportation, by requiring receipt and delivery of the mails at small stations, to specified distances, the transportation of mail clerks and their insurance against accident, provision of offices at transfer points, heated and lighted for the use of the railway mail service. And on such basis as the government elects to pay, because of the unbusiness-like methods which the law puts in force, it deprives the railroads of all four-year increments of revenue, by expansion of the business, which they have rightfully earned. On one road this has

amounted to 70 per cent of the whole volume of business.

18. This principle, however, is far from being generally conceded. Since there is in case of any product a certain part of the expense which is direct to each thing produced, it is assumed that it is proper to charge the remainder of the expense on the basis of so much of it as we have located. But the cost part and the use part of an expense are two radically different things. Because the grass is green is no proof that the sky is blue.

19. The same absurdity, in different form and modified degree, is involved in the effort to divide an undistributed expense on the basis of some common physical measure, as to divide the fixed expenses of railway operation between passenger and freight service on the basis of train mileage. If this were a universal and inflexible method of dividing an expense it would have the certainty of a physical fact and could be used as actual cost. But it is not real cost. However, the train mile theory of dividing joint expense is not without some value in practice. In the absence of any reliable method of watching the exact effect of decreased rates in increased gross earnings, it approximately fixes the proportion which a given service is made to bear of a fixed expense.

20. But the same kind of service may not be of equal value to each economic use served. Therefore, to make it an equal service to all, the differences are equalized by concessions to meet special conditions.

21. The sum of the individual uses constitutes a group of uses which is placed against that larger area of costs which it has been sufficient to incur. Thus it may be that the several passengers on a train may each pay sufficient to cover the expense of the ticket on which they travel. They contribute to the expense of

the train in the proportion in which they individually got use out of the train. This is assumed to be according to miles traveled. But the sum of all their uses must equal and exceed the cost of the train, because the train expense is a direct cost to the group of uses which it serves, although it may be a proportional cost only, to each individual use in that group. The principle of equalizing individual uses of a joint expense comes in time to apply in equalizing group uses of the joint expenses of larger area, which they together incur as a direct expense.

22. The first thought is that every use served should be charged at once with an equal proportion of all the outlay however indirect and remote. But we soon find that it is made up of distinctly different outlays, which only in different degrees are within our regulation. Some of it was spent long before. Some of it is partially spent already. Only a constantly dwindling proportion of the entire amount to be recovered, as we get back towards individual uses, is determined by whether we give a particular service or not. A given number of passengers at a particular time makes necessary the cost of an added coach. An average offering of passenger business over three months perhaps makes necessary the expense of a particular scheduled train. The added train has with others, constituted a certain number of passenger trains, that keep in use a given amount of rolling stock. A prospective volume of business, both freight and passenger, once justified the construction of the hundred miles of road. The added car can be dropped at once, the train periodically withdrawn. The added coaches and engine need not have been bought and maintained, or if already on hand, could be sold; the road itself may not be maintained; and finally the interest on investment can be defaulted.

23. The option whether we shall be at the cost of a

particular service by these successive stages becomes a weaker and weaker active force in determining expense as the area widens. Each group of uses are a first cause for their direct expense and plainly bear all of that. In addition they offer a surplus use or demand, which, passing into the next larger group, is the cause at the next point of option for incurring another and more general expense.

24. From this is plain the necessity of breaking up the entire body of expense into separable parts in order to locate the points of option. The problem of cost is first a thing of physical determination, and after that a matter of balancing use against cost, and finally a matter of equity of balancing use against use, as determined by the various economic conditions to be met and served.

CAPITAL, EARNINGS, AND EXPENSES.

1. Invested capital is expectation computed in dollars—it is outlay for expected return. It is like every act performed, based on *a priori* reasoning, assuming a given outlay will bring a stated result. Coming within the field of the laws of supply and demand, outlay and return, each acts upon the other to affect its value. At one time the cost of the outlay fixes the value of the product and again the price of the product puts the value on the outlay. Ownership implies full assumption of the speculative discrepancy whether it be loss or gain.

2. When capital is invested in some permanent form, the outlay cannot come back as a whole, but produces a periodic increment. And this periodic increment when extended to its equivalent at the prevailing rate of productivity of invested capital is return for the outlay. At that value the owner can at any time convert it into money in the open market. A railroad is such a fixed plant. The outlay can only be turned again into cash through the annual increment. The more permanent the form of investment and the longer the chain of processes from first outlay to return, the more does price instead of cost determine the value at any one time. For this reason the earnings of a railroad and not its cost are the basis of computing the present value of the property. According as these earnings, through a considerable period, tend to rise or fall, the basis for expectation is altered and the value of the property may be restated by increasing or reducing the capitalization. When values are scaled up in this way, in common parlance the stock is "watered." But under free com-

petition there is no reason why the increased revenue may not be funded, provided the increase be real.

3. Invested capital then, rudely, is annual income extended to its equivalent at the ordinary rate of expectation of profit. In case of simple ownership, the whole profit belongs to one capital account. But railroads have funded obligations of various orders which much complicate ownership. These, being funded, are permanent charges on the income of the road and must be considered as part of its regular capitalization.

4. Capital, as the word passes in common use, means the amount of capitalization. But on the theory that the capitalization is a statement of actual values which have been put into the property, it is assumed that the property is its equivalent and the word is used to designate both the rated value and the actual cost value of the property. When used in the sense of actual assets it is divided into "fixed" and "circulating capital." But with the expansion of business, the current liabilities constantly tend to exceed the quick assets. They are from time to time capitalized, by funding the floating debt. For this reason the Statistician of the Interstate Commerce Commission prefers to state them from the liability side of the balance sheet. Accurately there is no fixed capital. It is all constantly deteriorating and by the amount of the deterioration and renewal it is in circulation. But inasmuch as this deterioration and renewal is not shown, but the thing is kept at a fixed value, it may with propriety be called fixed capital. As distinguished from this, all capital which remains only temporarily in one form, but is subject to continual conversion into cash or various assets, is distinctly circulating capital. Fixed capital can only be converted into cash through annual income. Circulating capital can be converted into cash at any time. If we are operating at a loss, our circulating capital is being constantly absorbed or

our fixed capital is physically deteriorating without renewals. If we operate at a profit, either our circulating capital is increasing or our fixed property is being bettered. The income account can be adjusted to take up the fluctuations. Or, again, the income account can be "financed" to be kept at a fixed figure. Then the fluctuations will be absorbed either by the fixed property, in betterment or deterioration, or by the circulating capital, in increase or decrease. But circulating capital is determined largely by the conditions of operation, which may not be regulated at will, so that practically the fixed capital is generally made to absorb the fluctuations that occur in earnings.

5. To extend a periodic increment to its equivalent in capitalized value is most simple. But to determine, out of all the conditions affecting the property, how much is for renewal and how much can be charged to future return, is very difficult. Yet this must be done before it can be known what may be withdrawn from the property without impairing future earnings, or, in other words, what is the real increment. To the accountant the problem is stated in the form "What is expenses and what is construction?" If the outlay is currently consumed, it is expense. If it is not currently consumed, but is intended to extend its effects indefinitely, it is construction. We say "is intended" because the division between what is expense and what is construction is largely arbitrary. For there is no outlay some part of which is not currently consumed. The difference, in this respect of current consumption, is one of degree and not of kind. Some particular forms of outlay we aim to keep at the first physical standard by constant repairs which are charged to current expense. Thus ten new locomotives are charged to construction because they are intended to be kept at a constant efficiency which shall extend over an indefinite number of earning periods. Their current re-

pairs and renewal are charged to expenses. But they must inevitably wear out and their replacement with new engines is then also charged to expenses. This is because it is an outlay which is intended to restore what we have once set aside as invested capital. Some forms of outlay we aim to keep up to the first standard unimpaired, as an iron bridge or a section of roadway. Other forms of outlay, where not immediately consumed, are allowed to deteriorate until restoration is almost as great an expense as first cost. But the determining factor in charging them to expenses or construction is whether they are to preserve or restore an existing type or to raise the type or create a new type. This is on the theory that a fixed type has a permanent efficiency in producing earnings, which if maintained, extends over an indefinite number of earning periods. But the notion of such fixed types is generally limited to tangible, physical things. Costs that may have been equally or more effective to increase the earning capacity of the road, but which do not take shape in tangible things, are charged to expenses. Thus the salary and expenses of the traffic man, securing the settlement and opening up the industry of a new town, are called expense, but the cost of the new spur track to the town industry is called construction.

6. An outlay, therefore, to establish or raise a type which we intend to maintain and thus make it bear on an indefinite number of earning periods, and whose maintenance does not amount to complete renewal in one earning period, is properly construction. It may bear on these earning periods either by increasing the gross earnings or reducing the expenses and so increasing the net earnings.

7. Where maintenance during one earning period amounts to as much or more than the first outlay, plainly the first outlay has been currently consumed, allowing no part of its first cost to extend its use into

other earning periods. It is therefore not construction, but maintenance. A certain railroad in a large Southern city did not build into the business section of the town. As a result it got no business until it introduced drayage equalization. The competitors severely denounced this as unfair. But when submitted to arbitration, the verdict was that if the railroad had the right to buy the right of way and build into a central location, it had also the right to do the equivalent of that by indemnifying shippers for the expense of drayage to their depot, which was remote from the business district. Either method would accomplish the same result, but in the one case a first outlay put the railway permanently on an equality, while in the other case each outlay went no further than the single shipment to which it applied. The former would be construction, the latter would be expenses.

8. Where we limit this notion of construction to tangible things it is easy to fall into the error that maintenance is simply the maintenance of a physical thing in its physical measurements, whereas really it is the preservation of the earning efficiency of the thing maintained. As for instance, we may maintain our passenger station at a common point strictly up to its first standard, but meanwhile our competitor has built a commodious modern structure and attracted all the business. The earning value of our passenger station has seriously dwindled, but the earnings must bear the same interest on the first cost as they always did. If now we build a new depot the increased value of the new structure over the old cannot be charged to earnings in the indefinite future. It must be paid at once if we would have the charge against future earnings for this particular outlay, proportional to its contribution.

9. The forms that enlargement and betterment take, present great diversity. It may be four spikes to the

tie where there were two before, or a sixty-foot turntable where there was a fifty-foot turntable, or a heavier locomotive or a higher grade of coaches. But they all may be thought of under three heads, namely, (*a*) those forced by competition or legal enactment in quality of the service, such as more warehouse service and more convenient team tracks at a terminal, which we will call competitive betterments; or (*b*) extension of line to produce more service, which will directly produce more revenue; or (*c*) improvements to reduce the the cost of operation. The first is an adjustment of the money invested to keep it at its real value as determined by its earning capacity. The last two are not to absorb past adjustments of value, but to create new values as determined by earning capacities, and are proper charges to future earnings and therefore construction.

10. Losses, and accidents such as washouts, wrecks, etc., not peculiar to any one earning period, should properly have been anticipated by accident or loss funds, during the period when they were a contingency. But as this is seldom done, they should be closed out reasonably soon thereafter.

11. After it has been once decided that the cost of certain new work is properly chargeable to capital account as construction, it may yet be a matter of exceeding difficulty to determine just what is the amount of such cost. A case in point would be the building of an extension or tributary road where obsolete material, transportation, or general supervision are drawn from the parent road. The question arises on what basis shall the charges be determined. If only part of the ownership is in the parent road, plainly the new road must be considered strictly as a separate property and the market scale of charges should apply for all material furnished or service performed. But it may be some of the material has practically no market value,

or is the surplus utility of some service or of some part of the operations on the parent road which cannot be used there and which involves no additional cost. Such would be the salary of the general manager who devotes a small part of his time to supervising operations, or the hauling of material which involves a comparatively small direct outlay. In view of the partial ownership and the many mutual considerations that must pass which are not reckoned in money, it is entirely reasonable to adjust the charges for superintendence and like undistributable items on the theory that what is the opportunity of the selling road is equally the need of the buying road. The one may accept less than the unconsumed value and the other pay more than the scrap or useless value of material or service furnished, which could not otherwise be had.

12. In case a new road is owned entire by the parent road it is no more than a statistical division of the entire property. The accounts are kept separately to determine whether it is paying its cost and in case of its ever being detached as a separate property to offer basis for computing its value. In such case the earnings of the parent road during the construction period of the branch line would be swelled by the amount of the business from the branch line. But this increase would be in part deceptive, because it would not be available in cash, but in liens on a new and untried property where the element of risk must largely qualify their real value. It would seem to be impolicy to charge the new road full tariff rates for transportation and any profit on any other form of service performed, but only the actual direct cost thereby incurred. The reason lies probably in the fact that the branch line was built because it was a place to apply the surplus utilities of the parent road which had otherwise been wasted. When, added to this, the new line is a link or feeder, the relation between it and its parent line involves

exchange of service, outside of those that have an open market rating, which may far outweigh those computed in money. In such cases the distinction of the branch line as a distinct entity is seen to be most fallacious. It is part and parcel of the parent road, and the bookkeeping to determine its specific earnings and expenses may be most misleading.

13. A much-mooted question is, What is the present value of a railroad property which may be used as a basis for justifying its tariff of charges. Theoretically the statistician and bookkeeper has anticipated the question and his books are an exact statement of that value. He has first charged, at actual cost, all values that went into the property. From time to time he has written off the books changes in value of parts of the property due to wear deterioration, or antiquation, until they stand at the current cost of duplication. He has regularly taken out of the property from year to year, where he could, the normal profit on the investment. Where this profit has for several consecutive periods fallen to a lower or risen to a higher level, he has readjusted his valuation of the franchises to conform. But in practice he has done little of this. Items of property may have gone up or down and yet they stand on the books at first valuation. The speculative or fictitious values which have their place in railroad operation, as in all other forms of investment, he may have covered up in false valuations of parts of the property when they really should be held to an account by themselves as values of franchises, etc. It is a well-conceded principle of business that the seller may charge for his property all that he can possibly get, in the same way as he must also absorb all the losses of his business.

14. The adjustments to absorb these fluctuations may be in three ways: (*a*) either we may take them up entire in a single earning period, by charging them or

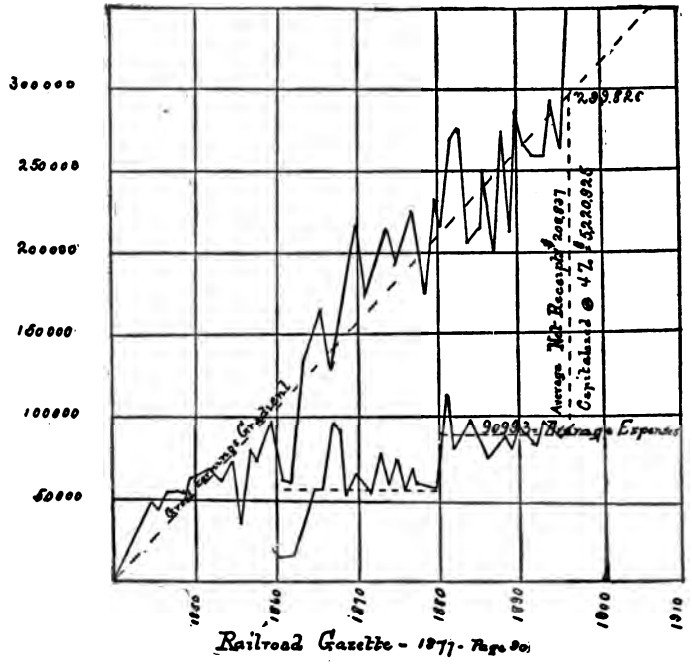
crediting them to earnings account; (*b*) they may be spread over as many earning periods as the management elect, by holding them in suspense as surplus or loss and wiping these accounts out from time to time; (*c*) they may be permanently funded by restating the capitalization, in which case their permanence is assumed.

15. Since the railroad ownership is in a large number of hands that may not be long continuous holders, it must always be a nice question to decide as to the probable permanence of any considerable fluctuation in earnings and so place it, that the loss or gain may fall equitably among consecutive holders. The public functions of a railroad bring it into great difficulty at this point. The public regard the railroad as a public monopoly, expressly created by a franchise, and any increase in the value of that franchise is public property. They at the same time insist that present value of the road should be computed from the basis of what it would cost to duplicate the property. But the difference between the first cost and the cost of duplication, in so vast a single property as a railroad, reaches an immense aggregate. If we apply that principle without permitting the road to enjoy the monopoly value of its franchise we impose on it all the loss of depreciation and prohibit it from capitalizing the profit of expansion.

16. The attempt to apply the two different principles must always produce conflict. The railroad has largely funded the full first cost of the property, offering as assets the property at what it first cost and not at present cost of duplication. The holders of these funded securities have not come into the enterprise as parties to the risk, where at the same time they may not share the speculative gain. Their claim represents the notion of stability of value, which may only be assured, as the cost of duplication becomes progressively less of

the first cost, by recouping themselves out of the increased value of the franchise due to the expansion of the business.

In case of earnings that are constantly expanding, while expenses remain as a practically fixed charge, it is plain that a capitalization based on the average earnings during a given period, would be unsatisfactory. Mr. Lewis Haupt, Consulting Engineer of the Monongahela Navigation Company, in the *Railroad*



Gazette of February, 1897, expresses such a case graphically by the chart above. Any appraisement of such a property must take cognizance of the annual average increment to earnings.

FUNDAMENTAL THEORY OF A RAILROAD.

1. The kinds of railroads and conditions of operation are widely divergent. Even for any one road the conditions which it must meet are liable to extraordinary changes. Our railroads are great trunk lines, in an open country or tortuous narrow gauges in the mountains, through expensive tunnels, across deep gorges and under great snowsheds or over miles of piling, or they may be rack roads to the very mountain peaks. The motive power may be steam or electricity. Some go at an appalling speed, carrying their passengers in rolling palaces and depositing them at luxurious public buildings that rival the finest architectural structures of the state. Others creep along, painfully slowly, over worn-out tracks to cross-roads destinations.

2. One road hauls passengers almost exclusively, another freight. This road may carry coal and pig-iron or ore, while another carries fruit or fresh meat that must be protected from the weather. Or it carries package freight or express or mail. One road operates under the most galling competition, another has a monopoly of its territory; this one does local business exclusively, that one is confined to through business or possibly switching. In one town the railroad warehouses freight free of charge and provides store-door delivery, while in another town it merely loads and unloads to a platform. In this State the people, the legislature, the courts are well disposed; in the next State they are harsh, arbitrary, meddlesome; they per-

haps prescribe the number of men to a train crew, the stations to be maintained, the trains that must be run, the crossings that must be bridged or protected, the rates that may be charged. Quite outside the calculation of business foresight, a rate may be cut by just the margin that makes the difference between bankruptcy and prosperity. The vast machine is composed of physical parts of track and engines and cars, but much of its value rests on prescriptive rights. A decision of court, a ruling of a railroad commission, or a new traffic arrangement may sweep 20 per cent. to 40 per cent. of its business from the rails as clean as a Western hurricane. One year our road may contend with freshets and washouts, the next with drouths and burning bridges. Last year boom towns were starting, great industries were begun, hordes of speculators and homeseekers were trooping to our territory. This year all is utterly collapsed. There is the appalling presence of death in every avenue of business. Our mushroom towns stagger on in a hopeless way with such unhappy population as cannot leave. The abandoned house, hotels, and business blocks glare on us as we pass, from empty windows and boarded-up doors, the gaunt specters of the life and bustle and hope of a year ago. The country is half deserted or infested with train stealers.

3. But the railroad cannot withdraw, nor stop for an instant. Into its operations is poured daily, even hourly, money in such lavish quantities as to appall the ordinary layman. There is no feature of the business whose expense is not far and away beyond the scale of ordinary private enterprise. The disappointed, failing in their expectations, look greedily on the great disbursements. They forget or will not see how narrow and frail a thing is the margin between receipts and disbursements. Discontent and populism frown on all sides. The railroad is harassed by legislatures,

mulcted by juries, annoyed by petty justices. The public prints take up the cry "monopoly." Social reformers, cross-roads agitators, college sophomores come forward with ready theories, to solve the intricate problems of transportation. And as the business steadily declines, competition grows fiercer and fiercer, until at last the railroad takes refuge in a receivership and delivers itself to reckless warfare. Little does the community know of the terrible pressure under which a conscientious railroad manager must work. And when all is done, he is not permitted to enter into the security and satisfaction of general confidence, but is distrusted, his motives impugned, and his achievements denied.

4. In all their varieties and degrees, and under all their different conditions and vicissitudes, railroads have this in common, that they use a large fixed plant and their product is public transportation. Their operation must involve a roadway over which to haul the goods, a rolling stock and motive power to carry them, the labor and supplies for performing the service, which are a current expense, and the general supervision that directs the forces. By this description they fall into a common class and on this basis their analysis and comparison statistically are taken up.

5. For purpose of statistics the whole operations are considered as mere play of cause and effect. The grand result is the revenue, and the grand cause by which that was made possible is the gross expense. In our statistical inquiry we reverse the order and begin with the earnings as the general cause against which we seek to relate the expense as the result. On this principle, starting with the general sequence of gross earnings and gross expenses, each in turn is broken up into links of successive sequences, having their own subordinate causes and effects. The general principle of an act or sequence is kept in mind as

being a body of applied causes, resulting in an equivalent body of results, of which only one or a limited number are the ones sought. The study is to locate and reduce and progressively eliminate these non-essential causes which apply against non-efficient results.

6. The task is not at all simple, nor are the results at all times finally certain, because some essential element in the analysis may have escaped attention. The extreme intricacy with which we are dealing, cannot be emphasized too much. In the practical management of a railroad, so wide is the area and so intricate the relation of all the causes and all the effects, that if we depart from existing types or methods in any subordinate part of the operations, it may be at risk of grave consequences that cannot be foreseen. Carelessly add but a name of six letters to a railroad's title and it will cost $6000 to paint it on the freight equipment. Inaugurate a new train schedule on the system and it will cost $400 for printing employees' time tables. Tighten the schedule of your fast train, and you may have to allow your less-favored competitor a differential which will cost more business than you have gained. Disturb an existing service by some change however slight, and it may make the difference between a good share of a competitive business and none at all.

7. Long practical experience with a mechanism so vast, so complicated, and so delicate has made the manager most cautious of change and wary of new and untried things. Much that is done may be by rule of thumb, but it is a rule that has worked before. But though he may hesitate to make change he cannot avoid the changes that are being made by causes outside his control and which he must meet. His economies are not in how little money he may spend, but how effectively he may spend it, regardless of amount.

He cannot always rely on what has been, but must sometimes construct for himself what may or might be, given the conditions which he has under consideration to apply.

8. He must not deal with impressions, but with facts and with carefully ascertained and measured facts, placed in their logical arrangement—and these are statistics. A prominent man looks in amazement at the vast suburban traffic of a large Chicago road, and gets the impression, which he passes to another, and which serves at a later stage of currency to bear the stamp of "credibly informed," that this particular Chicago road pays all the expenses of a big system out of the profits of its suburban business. The public find this to be amply confirmed, for are not the trains fairly jostling one another in their frequency? It is obviously an instance of most unreliable and misleading impressions. But the fault of substituting impressions for facts is not confined to the public.

9. The two great central features of a railroad, that together distinguish it from all other business, are universal public character of service and extent of fixed plant. The latter renders the law of increasing return the controlling principle of operation. On the one hand enter public, social, political, and general economic questions in steadily increasing complexity; on the other hand are the problems of cost, set up by progressive application of the law of increasing return. The railroad cannot escape its public character, nor can it avoid the practical considerations of expense, as it may be affected by the law of increasing return.

10. Transportation affects all conditions of life today perhaps more than any other organized industry that can be named. Statistical inquiry into the affairs of railroads cannot go far without discovering effects that must be related to causes outside the mere business operation of a private property. The statistician is

forced to take cognizance of these causes, to note their certainty, persistence and relative importance, as they enter to affect the quantities with which he is dealing.

11. The law of increasing return is, primarily, strictly a concern of operation. It is the principle by which a given outlay may be brought to the greatest productivity. It applies at every link throughout the great chain that leads up to the actual transportation furnished, as well as at the ultimate point of service to the public. But at this point, in application of the law, there has been built up a great plant, which results in a large undistributable expense to be apportioned over the units of service performed.

12. This apportionment rests on the basis of use, since it cannot rest on the basis of cost, as there is no direct cost. This use must be determined from conditions outside the railroad's operation. It involves public and general economic questions. Thus are united into a most complicated problem, the two principles of highly differentiated values and highly differentiated costs. The whole matter is first a question of fact; and aggregated and ordered facts that lead on to general principles are statistics.

INDEX.

I. S. C. C.—Interstate Commerce Classification.